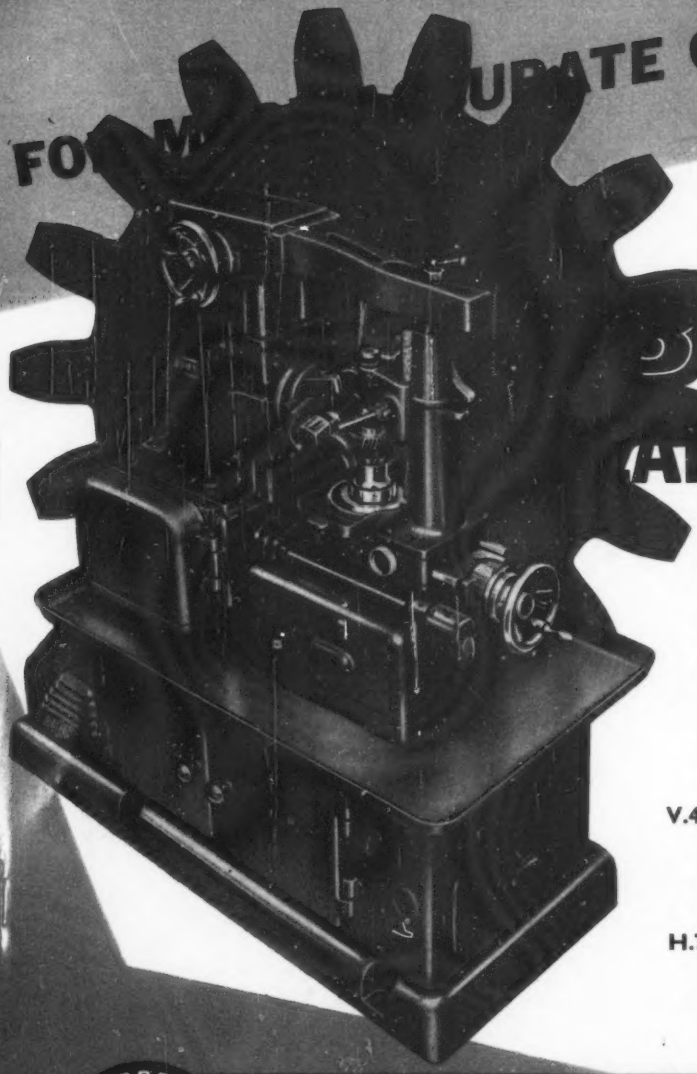
MACHINERY

SEPTEMBER 3, 1958 ONE SHILLING & THREEPENCE

FO[illegible]UR[illegible]ATE GEARS . . .



DOWDING

UNIVERSAL
AR HOBBERS

The V.8 is designed and built to produce more gears more accurately. Amply rigid for climb or orthodox hobbing. Built-in differential. Tangential feed and cam operated plunge feed if you need them. Hundreds of DOWDING hobbers are in operation where requirements are most exacting.

8″ diameter 7″ face width 12″ DP.

Your copy of the **NEW** *12 page brochure only awaits a line from you*

V.4 FOR THE SMALLER GEARS

4″ diameter 4″ face width 20 DP.

Fully universal. For spurs, helicals, worms and wormwheels. Built-in differential. Tangential feed if required.

H.7 FOR LONG SPLINES

7″ diameter 18″ hobbing length 8 DP.

Also for gears integral with long shafts, parallel and taper serrations and gears in between shoulders. Fully universal with built-in differential.

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346 KENSINGTON HIGH STREET, LONDON, W.14

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* This makes sense
— Please check MP

Who buys tool bits for your shop?

Here are some things he should know . . . .

No tool bits can be better than the steel they're made from

'Eclipse' tool bits are made from H3 cobalt high speed steel, melted, heat treated and finished under one control to strict and rigid standards of quality. That's why the consistent performance of 'Eclipse' tool bits can be guaranteed.

Cheap tool bits can mean dearer production costs

When you buy tool bits you buy cutting capacity and it pays to buy the best. 'Eclipse' tool bits keep keen cutting longer than inferior tools — reducing time out for regrinds and increasing production.

Tool bit holders can help with production too

'Eclipse' tool bit holders have been specially developed to get the very best from 'Eclipse' tool bits. They have a patent clamp, adjustable to variation of tool bit size which holds the tool absolutely rigid eliminating any tendency to "chatter."

This is just what we need

'Eclipse' tool bits and tool bit holders are the ideal cutting combination

specify Eclipse TOOL BITS

Made by James Neill & Co (Sheffield) Ltd and obtainable from all tool distributors

UT 13

Ask the machine shop to check this

"Do the job properly– with Wild-Barfield furnaces"

Where heat-treatment is concerned—are you doing the job as economically as possible? It's surprising the number of people who invest in expensive machine tools—and then spoil a good job in outdated furnaces. And the result? Rejects—time, money and probably customer goodwill lost. More and more people are relying on Wild-Barfield equipment. Write for full details of the Wild-Barfield range and see how you can save by changing to modern, electric furnaces.

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ELECTRIC WILD BARFIELD FURNACES

FOR ALL HEAT-TREATMENT PURPOSES

WILD-BARFIELD ELECTRIC FURNACES LIMITED

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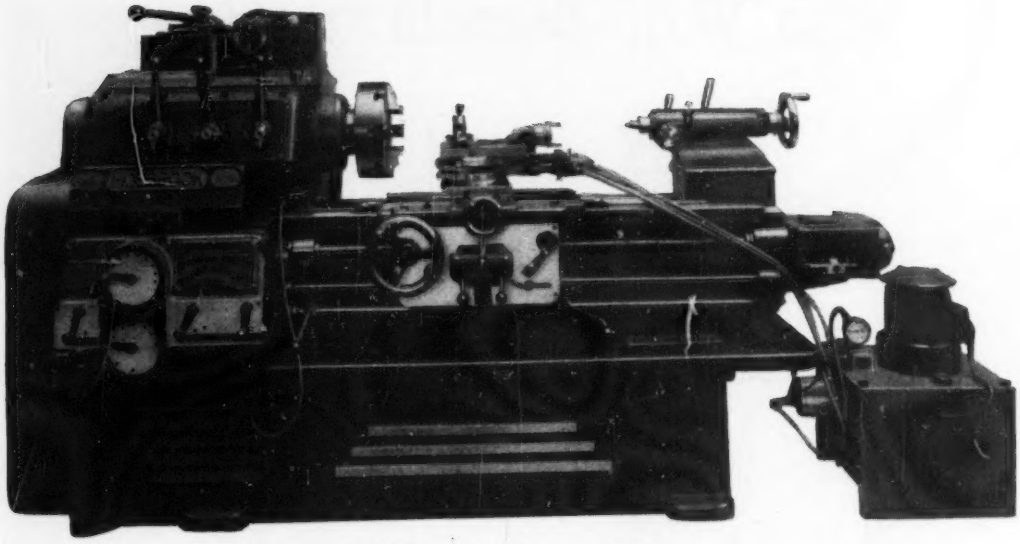

MODEL "M" No. 15/20

MOULD-MAKERS' LATHE

THE LATEST DESIGN OF MOULD-MAKERS' LATHE HAS INCREASED SWING OVER BEDWAYS (21") AND AN ADDITIONAL UNIVERSAL HYDRAULIC SLIDE FOR SQUARE SHOULDER WORK AND PROFILING IN ANY DIRECTION. NON CIRCULAR SHAPES ARE PRODUCED FROM A REVOLVING PATTERN IN ADDITION TO NORMAL PROFILING BY USING TWIN HYDRAULIC UNITS.
36 SPINDLE SPEEDS, FORWARD AND REVERSE RANGING FROM 0·15 TO 1,000 R.P.M., BUILT-IN PITCH VARIATOR FOR MOULD THREADS.

The Finest Lathe in its Class

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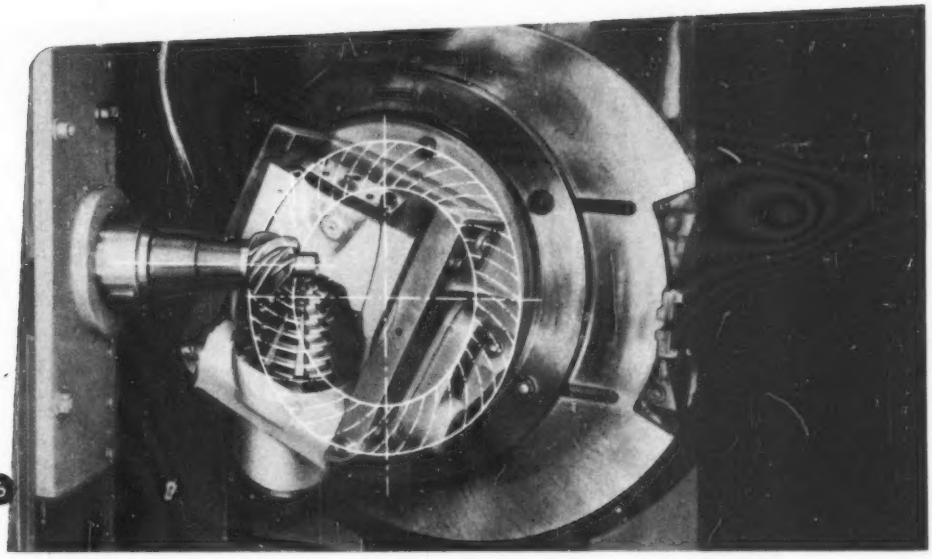

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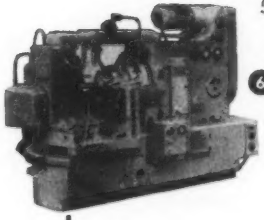
For more than 30 years

KLINGELNBERG PALLOID SPIRAL BEVEL GEARS

(used in all industries, and especially in the manufacture of transport vehicles.)

The Klingelnberg method is the only one producing spiral bevel gears by the use **of hobs.**

1. **Simple maintenance** of the **very accurately ground** hobs, and therefore high and constant accuracy of the gears.
2. Quiet running of the gears even in the case of displacements due to crowning flanks and suitable area of contact.
3. **Easy positioning of area of contact** with normal hobs by **machine setting** only and therefore absolute repeatability.
4. **Long life through sturdy teeth** with **even tooth thickness** and **efficient** tooth root radius.
5. **Simple calculation** and **setting of machines** and therefore very economical for cutting individual gears and for mass production.
6. **Spiral Bevel Gears for intersecting axis and offset axis can be cut on the same machine with the same standard hobs.**



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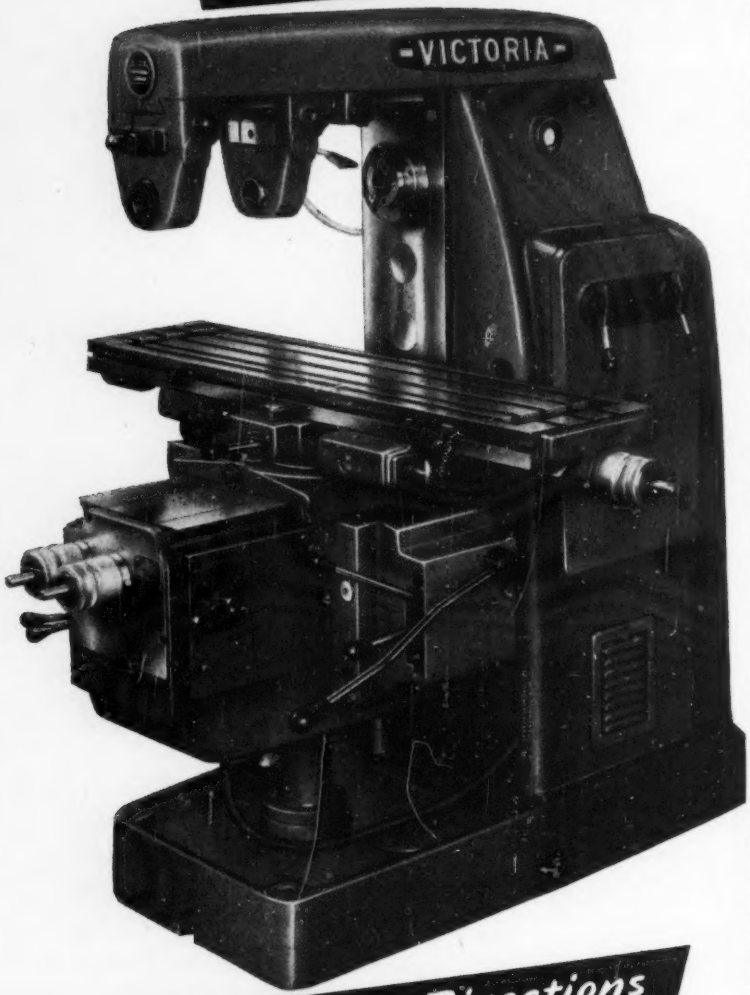
VICTORIA

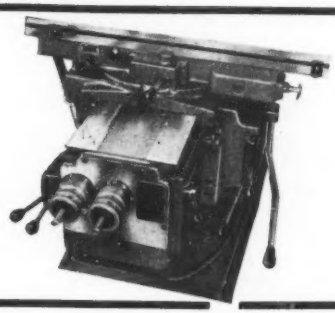


Rapid Traverses in all Directions

48in. by 11¾in. table—30in. longitudinal traverse. 12 spindle speeds—30-1050 rpm. or 43-1500 rpm. 18 table feeds ·65-15in./min. alternative ranges available. 5 hp. motor. Backlash eliminator standard equipment.

Rapidmil SERIES

the latest addition to the most popular range of **MILLING MACHINES**

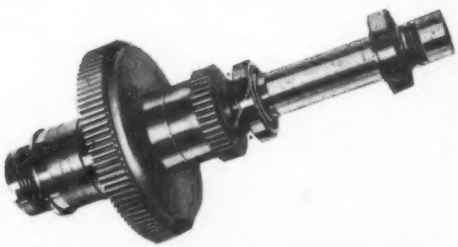


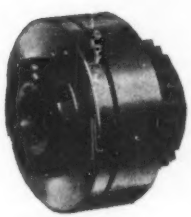
SIMPLICITY

Independent, directional table controls unaffected by direction of spindle rotation. Single lever engagement of rapid traverses.

POWER AND RIGIDITY

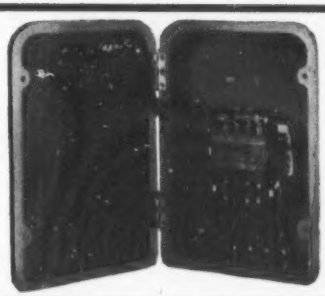
Final drive is large gear weighing over 45 lbs. permitting maximum rates of machining with excellent finish.





SAFETY

Feed drive is transmitted by overload clutch set at works to transmit maximum power.
Totally enclosed switchgear easily accessible through hinged cover.



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Tel: ELGar 4050 (10 lines) Grams: Elliottona, Harles, London
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..and now the R.44

-for piercing *through* Templates!

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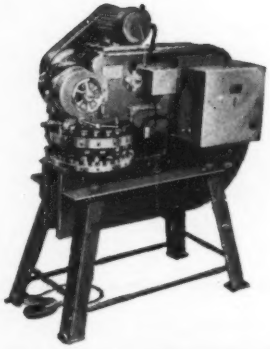
WIEDEMANN
Turret Punch Press

Piercing through templates, this new Wiedemann model gives faster than ever piercing on longer runs. Templates are fully protected — the press cannot trip until the punch has fully entered the template opening. Rack or standard gauges are available if required.

Punching pressure ... 30,000 lb.
Throat depth 28" ... 1 HP. Motor
16, 18 or 20 turret stations

There's a Wiedemann Turret Punch Press for every short and medium run piercing job. Hand or power — 15,000 to 160,000 lb. punching pressure.



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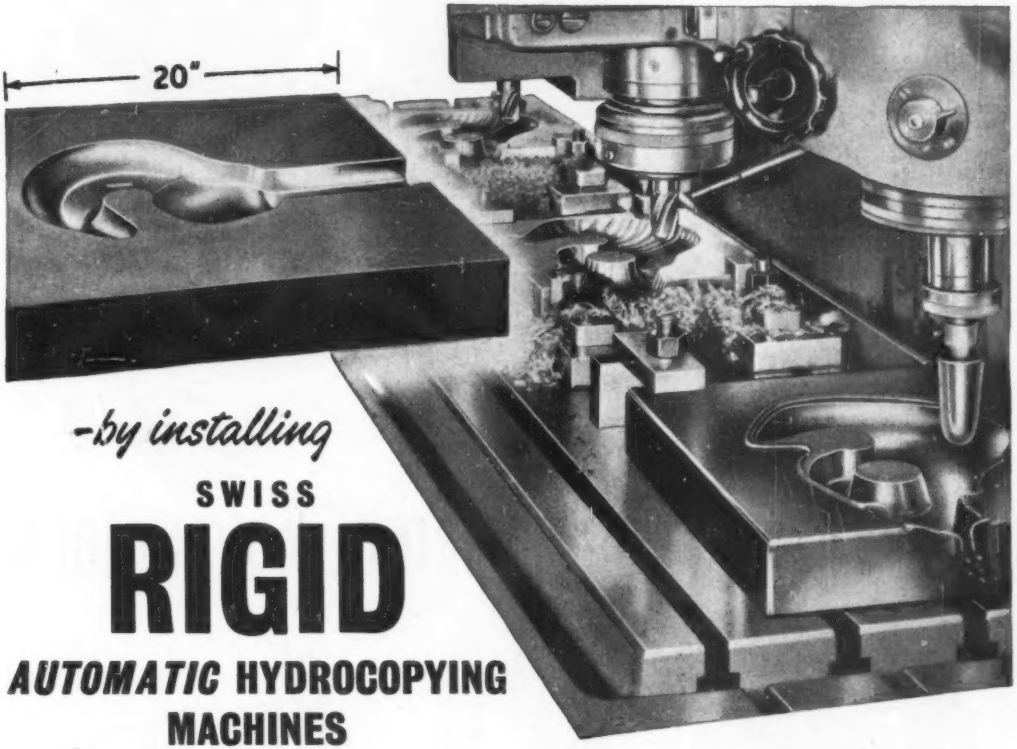
Solve DIE SINKING and PROFILE MILLING Labour Problems



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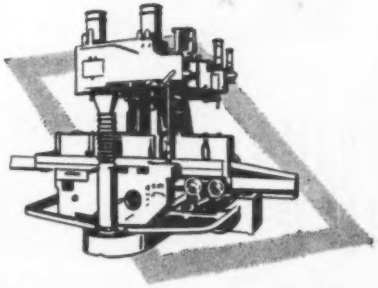
AUTOMATIC HYDROCOPYING MACHINES

Fully automatic copy milling in all three dimensions solves all die sinking and profile milling labour problems once and for all. 360° profiling without circular table and at constant feed. Copies vertical angles up to 90°. Light tracer pressure permits use of wood or plaster models. Reverse image attachment enables top and bottom dies of either hand to be made from the same master.

Standard table sizes up to 92.5" x 25.6"
One, two, four or six spindles



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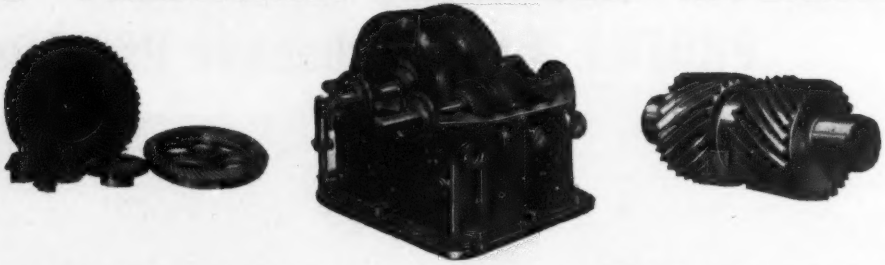
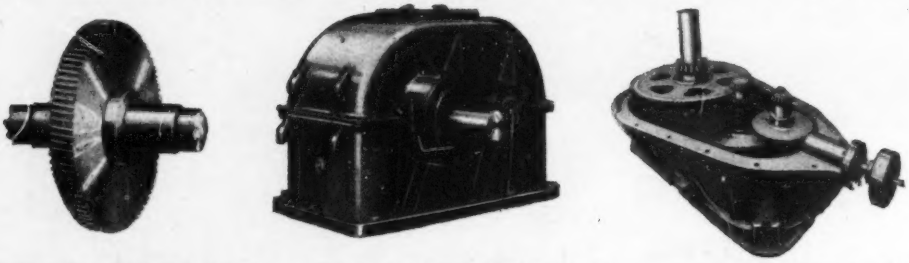
THE PRACTICALLY UNLIMITED APPLICATION



OF REID GEARS AND DRIVES OFFER



OUTSTANDING ENGINEERING ADVANTAGES

SPIRAL BEVELS UP TO 34" DIA. & OVER
HIGH SPEED GEARS UP TO 3000 H.P.

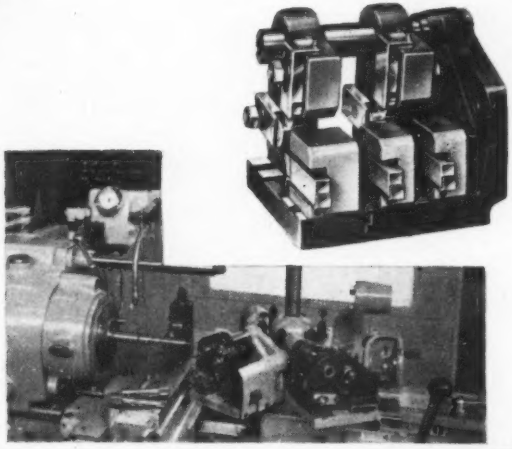
Reid

We can now quote quick delivery of all gear units. Write or 'phone Johnstone 861 for full details.

Every Type—Every Size—For Every Need.

THE REID GEAR CO. LTD., LINWOOD, NR. PAISLEY

For stepped diameters at High Speeds

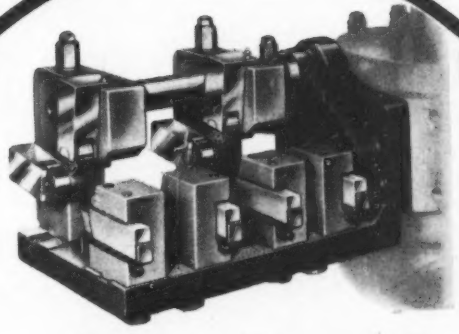


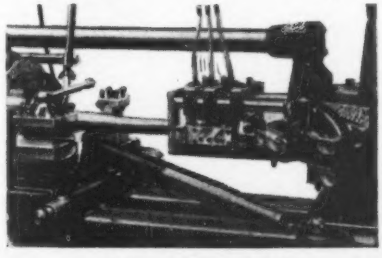
MULTIPLE TOOL HOLDER FOR CAPSTAN LATHES

Ward

Multiple Roller Turning Toolholders

Constructed for turning one, two, three or more diameters with tungsten-carbide tools, these holders present the tools to the work in quickly set robust slides having independent adjustment. The roller holders are interchangeable and can be locked in any position along the body.





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MOST SIZES FROM STOCK OR EARLY DELIVERY

H. W. WARD & CO. LTD.

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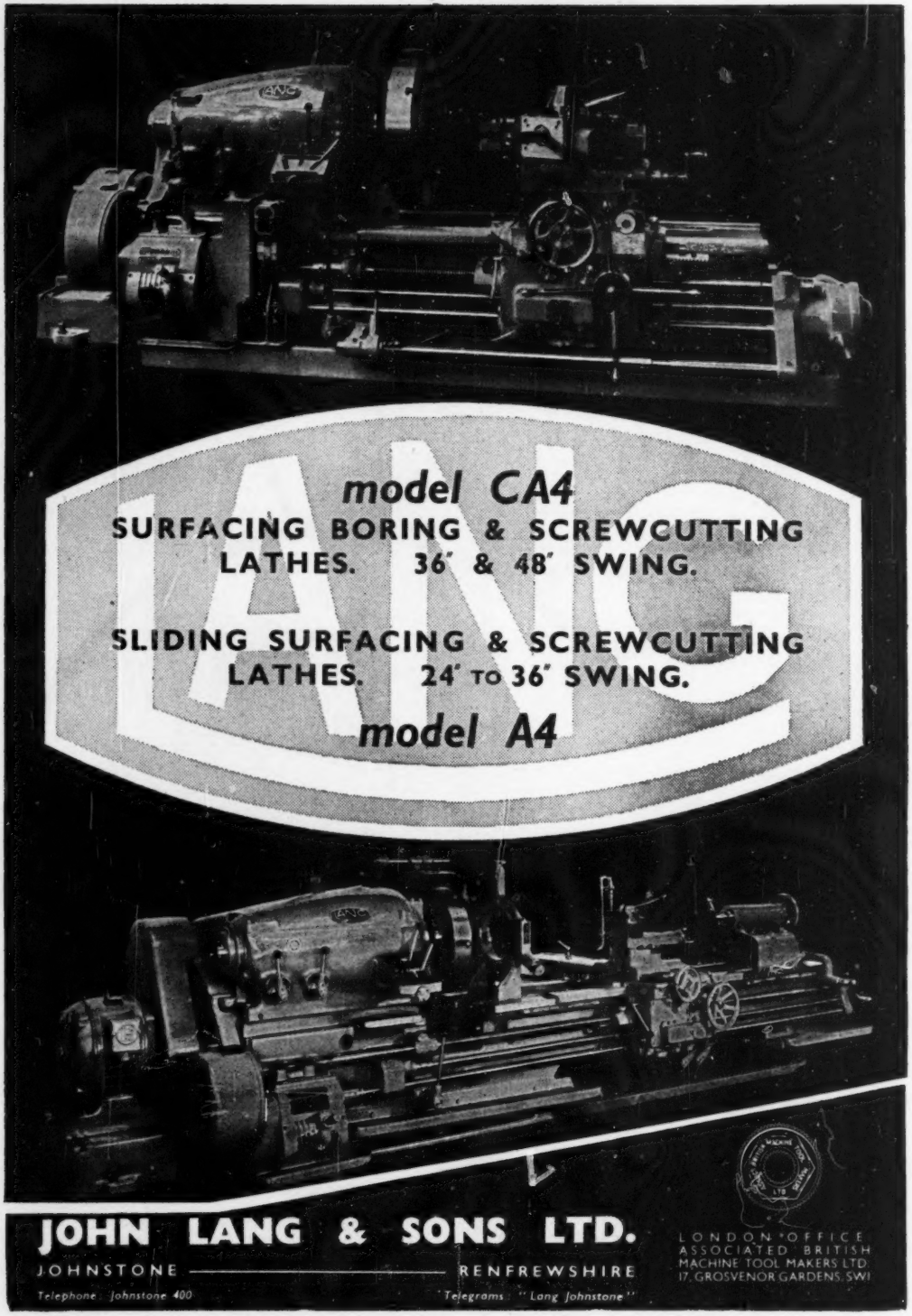
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model CA4
SURFACING BORING & SCREWCUTTING
LATHES. 36" & 48" SWING.
SLIDING SURFACING & SCREWCUTTING
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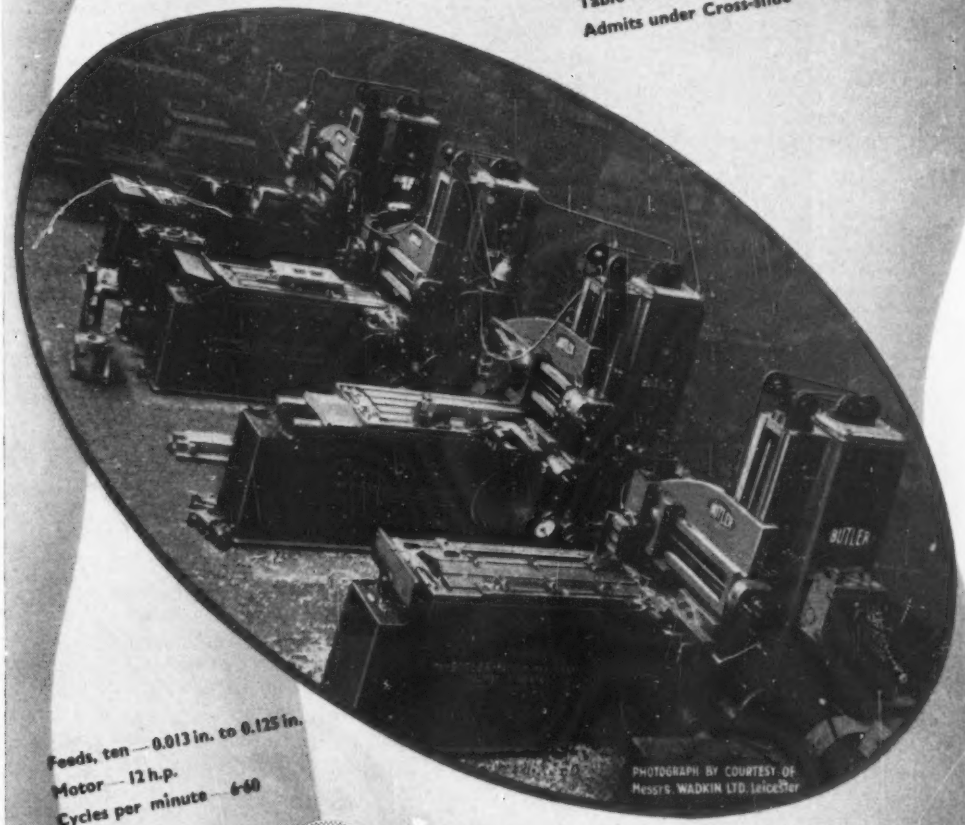
L2T5M

36 in STROKE OPENSIDE CRANK PLANER

Stroke — Max. 36 in., Min. 4 in.
Table — Length 48 in., Width 23 in.
Admits under Cross-slide — 24 in.



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Feeds, ten — 0.013 in. to 0.125 in.
Motor — 12 h.p.
Cycles per minute — 6-60

The BUTLER MACHINE TOOL Co. LTD
HALIFAX ENGLAND
FOR PRECISION PLANERS SHAPERS SLOTTERS
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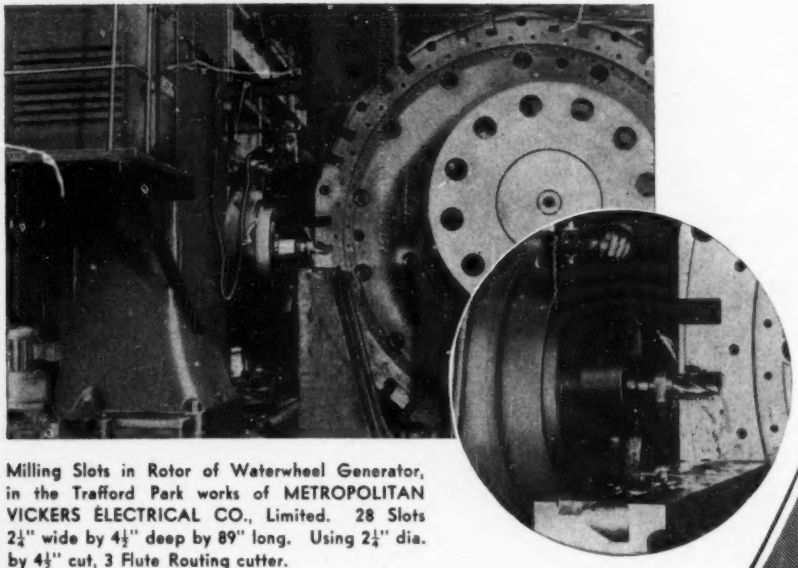
ALIVE TO THE NEW AGE

METAL REMOVAL MADE EASY WITH
CLARE ROUTING CUTTERS



Milling Slots in Rotor of Waterwheel Generator, in the Trafford Park works of METROPOLITAN VICKERS ELECTRICAL CO., Limited. 28 Slots 2¼" wide by 4½" deep by 89" long. Using 2¼" dia. by 4½" cut, 3 Flute Routing cutter.

3 FLUTE ROUTER

PROOF POSITIVE

Test Cutting BSS.328 (.60/.65 carbon), an 1⅜" 3 Flute Router cut 10.31 cu. ins. per min. at 10" feed.

HIGH RAKE : HIGH SPIRAL
MAXIMUM % CHIP AREA
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HIGH POWER CUTTING

CUT BETTER WITH "Clare"

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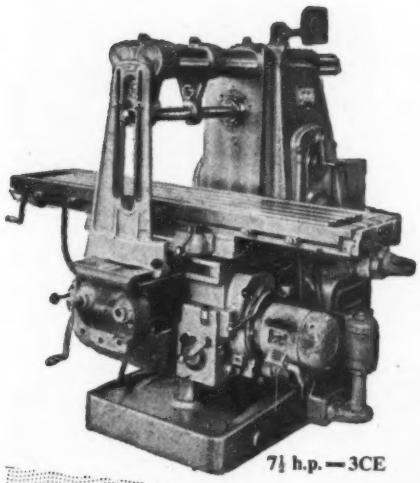
No. 4 of a series illustrating the Clare Milling System.



7½ h.p.—3CE

The ever increasing range of C.V.A. Kearney and Trecker Milling Machines, built by C.V.A. Jigs, Moulds and Tools Limited under licence from the Kearney and Trecker Corporation, Milwaukee now includes:

3 h.p. 2CE with 16 speeds

25 to 1,300 r.p.m. (Horizontal) 30 to 1,575 r.p.m. (Vertical)

and **16 feeds** — ½ inch to 25 inch

7½ h.p. 3CE with 16 speeds

25 to 1,300 r.p.m. and **16 feeds** — ½ inch to 25 inch

Both models are fitted with independent feed drive motors and are available as Plain, Universal and Vertical styles. Both Plain and Vertical Machines can also be fitted with automatic cycle table control.

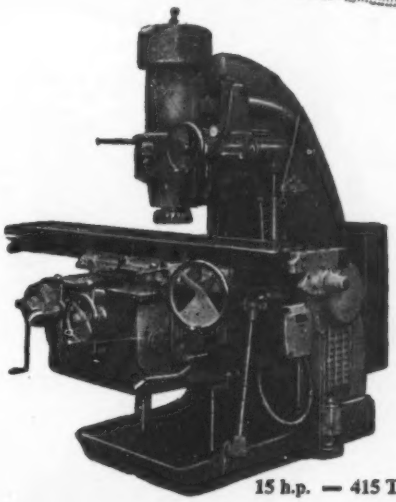
MILLING KEARNEY & TRECKER MILWAUKEE MACHINES

Complete series of Model 3 and 4 T.F. Machines in Plain, Universal and Vertical styles from 10 h.p. to 30 h.p. Monolever and automatic cycle table control is standard on all styles.

The T.F. range features twin vertical screws giving equal weight distribution and increasing stability under the heaviest cutting loads.

Also available is the 2D Rotary Head Machine with its unique action enabling the most complex jobs to be completed in a single set-up.

Write for details of the CE T.F. and 2D Rotary Head Machines.



15 h.p. — 415 T.F.

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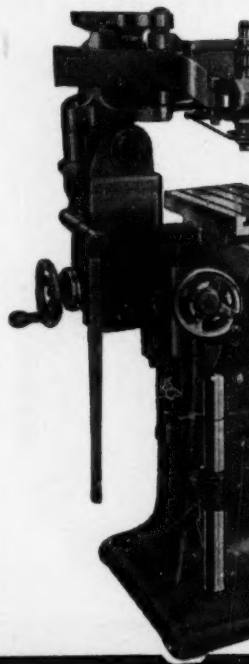
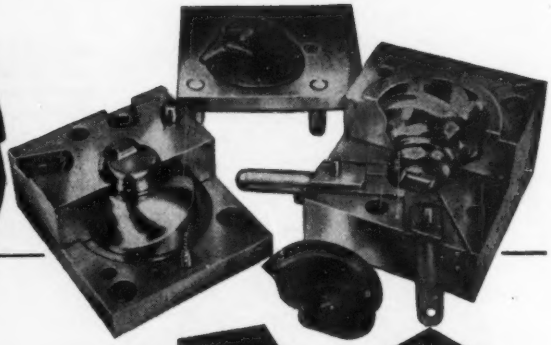
For two- and three dimensional reproduction





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DIESINKING MACHINES—
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82-84 COLESHILL STREET · BIRMINGHAM · 4
PHONE ASTON CROSS 3264 (7 LINES) GRAMS 'VIKING,' BIRMINGHAM

CARY 'K.M.V.'

VERTICAL COMPARATOR

For direct or comparative measurements within 0·00005" (0,001 mm)

RANGE 0 to 0·4" (0 to 10 mm)

The micrometer combined with a high precision dividing plate permits direct setting of the table at any point of its movement in steps of ·0005" (or 0.01 mm). The dial indicator graduated in ·00005" (or 0,001 mm) shows the deviation from the setting value of the work piece being measured. This solution is as quick as it is accurate and ensures remarkably true readings.

A knife edge engaging between two teeth of the dividing plate clamps the micrometer head in position.

The lever provided on the side of the instrument enables the operator to disengage and re-set instantaneously.

On assembling the instrument progressive errors of the micrometer screw are corrected by means of a special device.

VARIETY OF TABLES AND TUNGSTEN CARBIDE CONTACT POINTS TO SUIT ANY REQUIREMENTS

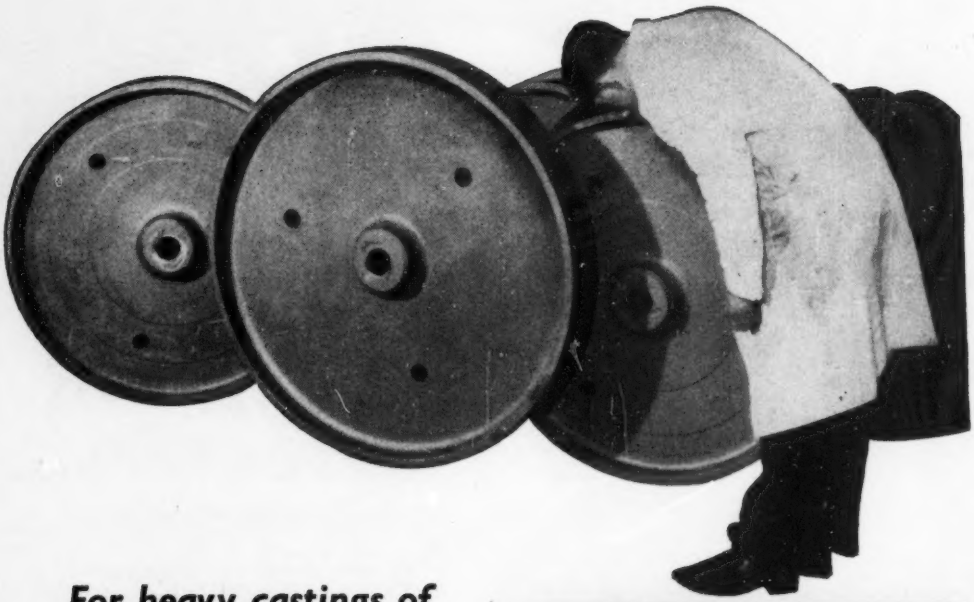
Sole Distributors in U.K. and Commonwealth:

MICROTRON LIMITED

31 HANWORTH RD. FELTHAM MIDDX

Tel: HAMpstead 3855/9949

SPECIFICATION	INCHES	MM
Capacity of instrument	·4"	10 mm
Adjustable by	·0005"	0,01 mm
Range of dial indicator	± ·002"	± 0,05 mm
Graduation	·00005"	0,001 mm
Weight of instrument	6 lbs.	2,7 kg.
Total height	8·5"	210 mm
Pedestal dimensions	4" x 4"	105 mm x 105 mm



For heavy castings of special properties or for small repetition work . . .

HARPER CASTINGS

Each of these 12 cwt. band saw wheels handles 120 h.p. and the peripheral speed is in excess of 9000 ft. per minute! As the customer required them to be *machined all over*, all surfaces had to be completely free from defects, hard spots and cavities.

Right: Lock cover weighing 9 oz., with a fine skin finish.

Harper quality covers Grey Iron, Spheroidal Graphite Iron (Mond Nickel Licence) and Meehanite castings. Also Metal Pressings, machining, enamelling and other finishes and sub-assembly work.

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TYPE 'A'

High Quality, Medium Capacity Lathes

These Swift lathes are capable of heavy-duty cutting and the range of speeds provided is adequate to take full advantage of carbide tooling. Available in two sizes, Type 9A with swing over bed 18½in. by 4ft. between centres, and Type 11A which swings 22½in. by 5ft. 9in. Write today and ask for the complete specification of Swift 'A' type lathes.

GEORGE SWIFT & SONS LTD.
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Sales & Service for . . . **DRUMMOND-ASQUITH** . . . the British Isles

DRUMMOND-ASQUITH (SALES) LTD., KING EDWARD HOUSE, NEW ST., BIRMINGHAM

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S 301

THE LINDNER WORM AND THREAD GRINDING MACHINE

Distance between centres .. 32in.
Maximum grinding length .. 20in.
Maximum grinding diameter .. 10in.
Maximum helix angle right and left 40°

External and internal grinding with single and multi-profile wheels.

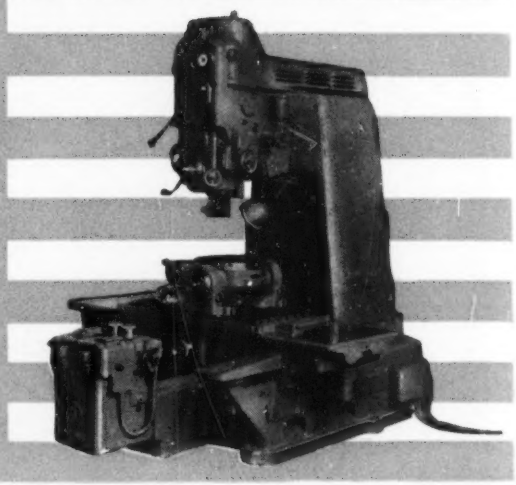
Automatic in-feed grinding.

Other models of thread grinders available for continuous thread up to 13ft.

LINDNER

THE LINDNER JIG BORER

- Optical adjustment
- Measuring system free from wear
- Pre-selection of adjustments
- Projection optics
- Open-front design
- Automatic locking and releasing of the co-ordinate table and boring head
- Centralized lubrication
- Setting accuracy 0·00004in.
- Spindle Speeds 25—1900 infinitely variable.



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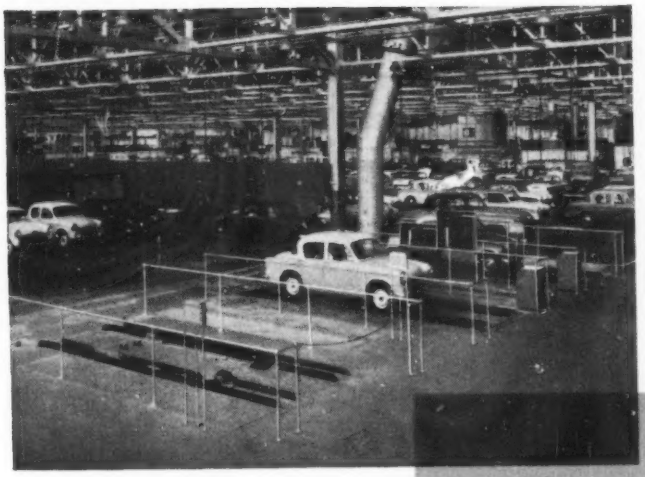
145-157 ST. JOHN STREET, CLERKENWELL, LONDON, E.C.1

Telephone: Clerkenwell 1010 Telegrams: Lockstone-Smith, London



This car testing machine is operated by Keelavite hydraulics. It is installed at the Rootes Group Ryton factory.

HYDRAULICS IN ENGINEERING

We at Keelavite are a team of experts in the design, installation and maintenance of complete hydraulic systems. We are ready to accept full responsibility for the proper working of all our installations, including all electrical or other control equipment.

Not only this, we are the manufacturers of the largest range of hydraulic units in the United Kingdom.

We are, of course, fully experienced in special applications of hydraulic power for the engineering industry.

KEELAVITE
Hydraulics
GENERAL ENGINEERING DIVISION

THE RECOGNISED AUTHORITY

KEELAVITE ROTARY PUMPS & MOTORS LTD
ALLESLEY, COVENTRY Telephone: Meriden 441
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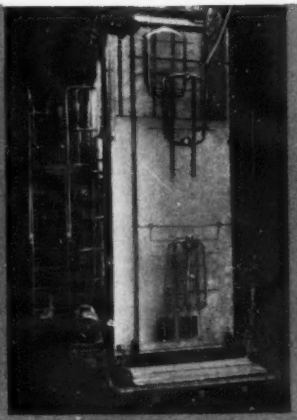
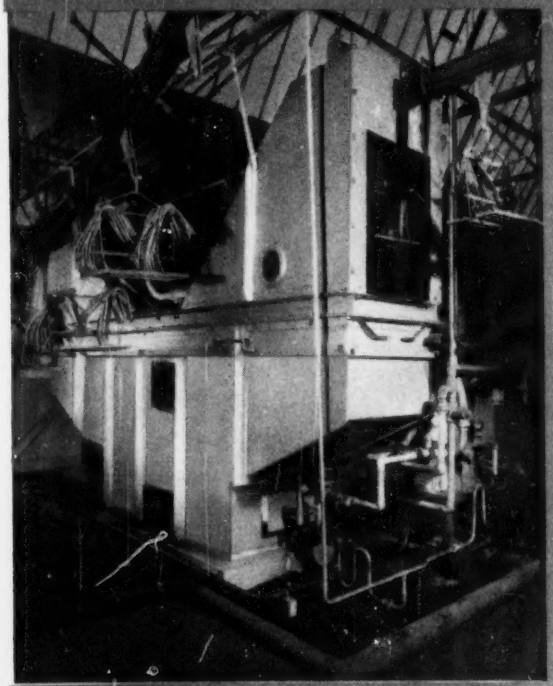
B2

1933

Morris Motors Ltd. installed one of the first-ever continuous I.C.I. metal degreasing plants. This was arranged for degreasing radiator shells, hub caps, etc. after polishing, and provided liquor, vapour and jetting treatment with trichloroethylene. After 24 years this plant continues to give excellent service, degreasing approximately 30,000 assorted articles per week.



One good plant sells another



1956

After many years' practical experience in the design and construction of continuous plants, I.C.I. supplied a second plant, fitted with a monorail conveyor to link up with the Firm's production line, and arranged for boiling liquor treatment to remove polishing compound from motor car windscreen and window frames. After leaving the plant, stainless steel parts are packed for despatch while those in brass and mild steel pass to the painting shop.

The new plant in service.
For advice on metal degreasing problems, consult

IMPERIAL CHEMICAL INDUSTRIES LTD., ICI **LONDON, S.W.1**

BP.253

Typical

HIGH TENSILE STEELS

by **FIRTH BROWN**

ALLOY STEELMAKERS · FORGEMASTERS · STEEL FOUNDERS · HEAVY ENGINEERS

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WHEN USED FOR BORING

LOCATES WITH REPETITIVE PRECISION TO 0.0005"

AT BARNETT BROS. (GUILDFORD) LTD

We purchased this machine just over a year ago and it has been in constant use since then: it has given no trouble whatsoever,

We have the standard measuring equipment and with this we are spacing holes on jigs to ±0.0005" of nominal position.

- Spindle hardened and ground on Timken precision roller bearings.
- Head with 3in. power down feed, can be swivelled through 360 deg.
- Table feed, automatic 18in
- Cross feed 6½in., vertical 14½in., both hand.
- Spindle to table 15in.
- Spindle speeds 50 to 1,000 r.p.m.
- Table working surface 30in. by 8½in.

VERTICAL MILLING MACHINE

WITH POWER DOWN FEED & GAUGE BLOCK MEASURING EQUIPMENT.

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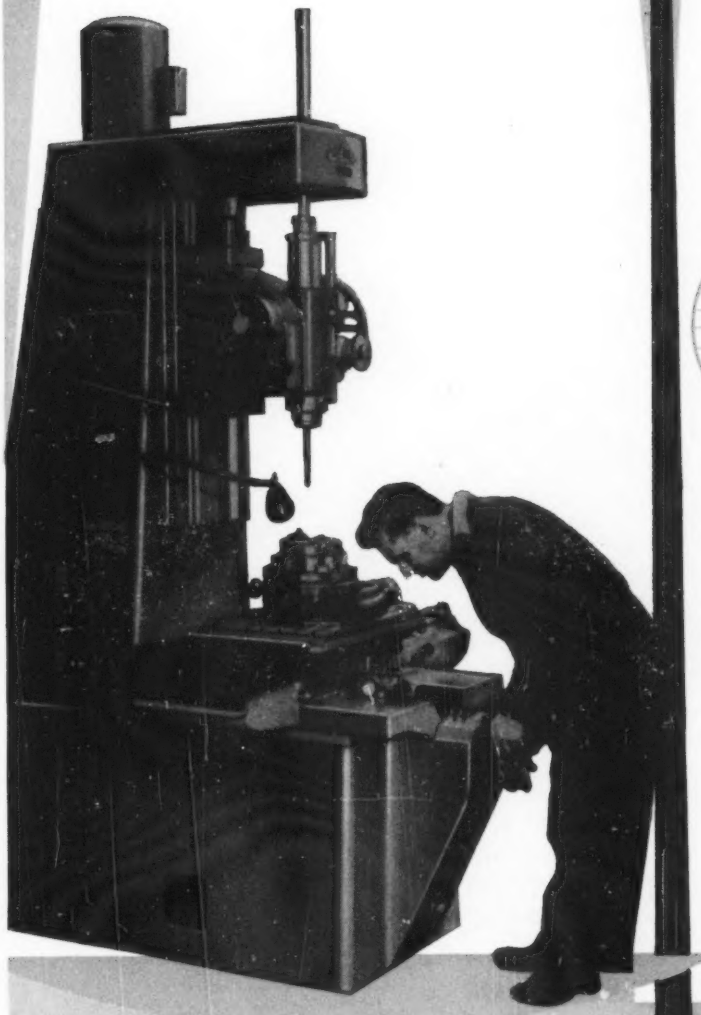
price for capacity



With over half-a-century's precision engineering experience and twenty years devoted to specialised development of jig boring machines, Newall proudly acclaim model 1520 as an outstanding achievement in their long series of successes. Material, craftsmanship, performance and accuracy of the machine set a new standard for medium capacity jig borers, produced at a price which will appeal to the toolmaker or large user.

the world's best value

principal features

- TABLE SIZE 15" x 20"
- DESIGNED FOR TOOLROOM WORK OR LIGHT PRODUCTION BORING
- COMPLETELY SELF-CONTAINED
- 12 SPINDLE SPEEDS IN RANGE 67–3,000 R.P.M.
- 3 POWER FEEDS UP AND DOWN
- SIMPLE TO INSTALL, OPERATE AND MAINTAIN

NEWALL MODEL

1520

JIG BORING MACHINE

ask for publication 106/58

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Service possible. These

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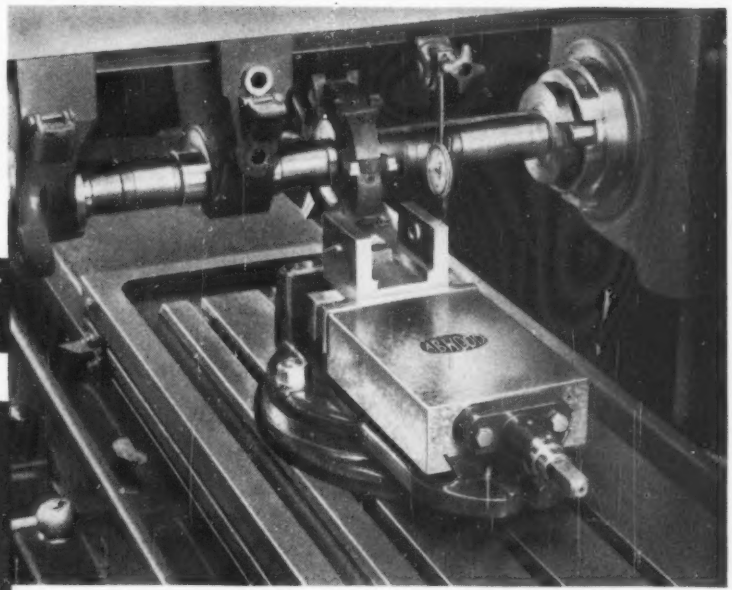
THE ABWOOD MODERN MACHINE VICE

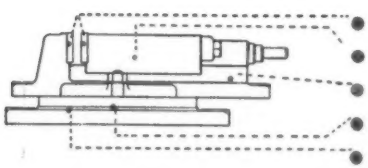


THE VICE WITH THE SLIDING JAW WHICH CANNOT LIFT AND TILT THE JAW

Clocking set-up of Drill Jig before milling faces for insertion of hardened location strips. This work-holding problem was resolved by the use of an Abwood Machine Vice thus ensuring complete absence of any lift.

FULL RANGE OF SIZES AND TYPES FROM 3" to 15"

VISUALISE WHAT AN IMMENSE SAVING THIS MEANS



- **PRECISION GROUND CARBON STEEL JAWS**
- **SLIDING JAW MACHINED OVER THE WHOLE OF ITS SURFACE FOR USE OF SCRIBING BLOCK**
- **ENCLOSED SQUARE THREAD SCREW HARDENED ON THE END AND 'THRUST'**
- **MACHINE DIVIDED SWIVEL BASE INDEXED THROUGH 360°**
- **ALL CASTINGS IN HIGH TENSILE 'MEEHANITE'**

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Telephone : Dartford 5271 (5 lines) *Telegrams: ABWOOD, DARTFORD*

MV-I

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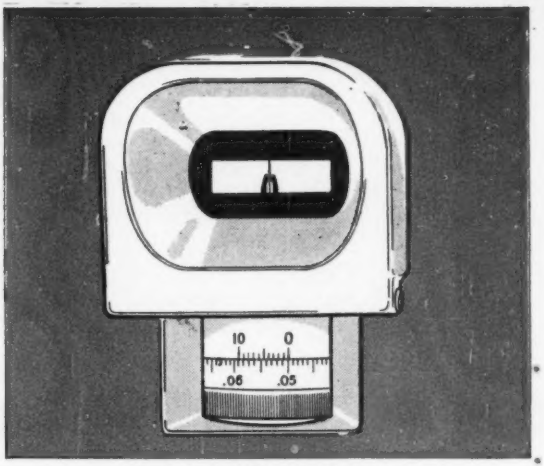
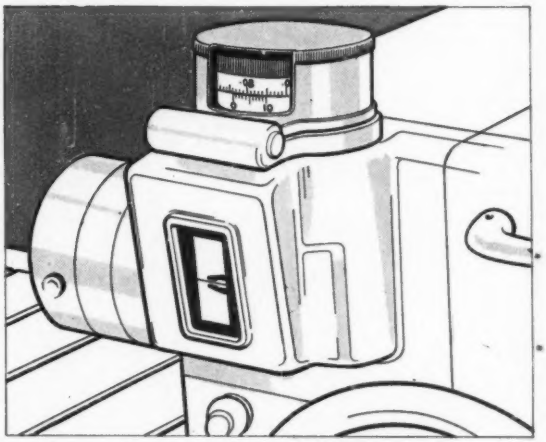
ACCURACY at a glance

With projection screens arranged on the bed, horizontal head and cross-rail, this extremely accurate jig boring and milling machine is capable of high output in large-capacity precision work. The projection screens show magnified images of the standard scale graduation lines, enabling a high degree of setting accuracy to be obtained together with exceptional ease of operation. The spindle running true to within *.00005 inch (0.001 mm.)* of very robust design revolves in rigid reinforced tapered roller bearings of GSIP manufacture.

For permanent working accuracy, the elevating screws of the cross-rail are hydraulically relieved before being electrically driven, so that the upper flanks of the threads on which the cross-rail rests are not subjected to wear.

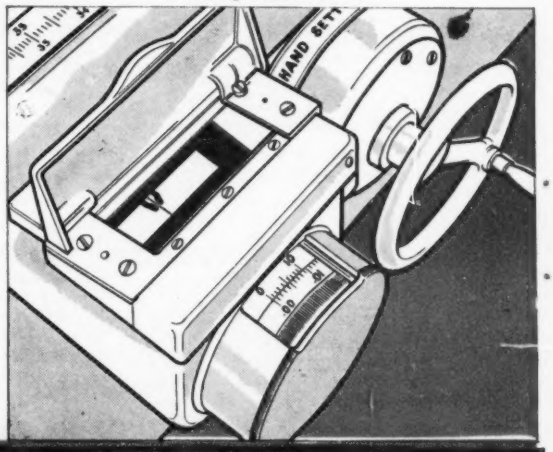


Viewing screen on cross-rail.



Viewing screen on horizontal head.

Viewing screen on bed.



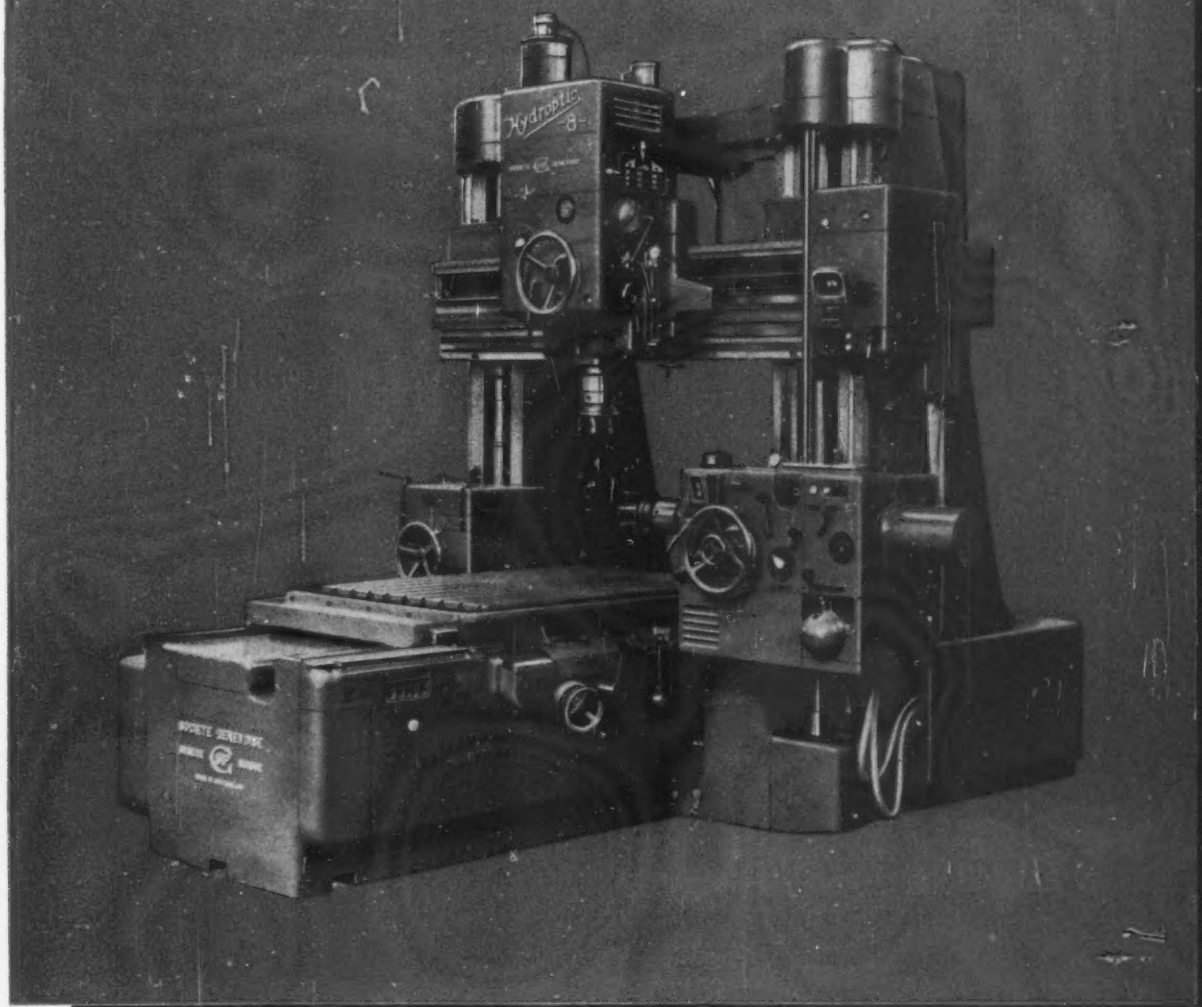
The installation and service of this machine is carried out by the Area Engineers of Sogenique (Service) Ltd., under the GSIP guarantee. For literature or further information please write or telephone.

SOCIETE GENEVOISE LTD

NEWPORT PAGNELL, BUCKS. TELEPHONE 4[illegible]

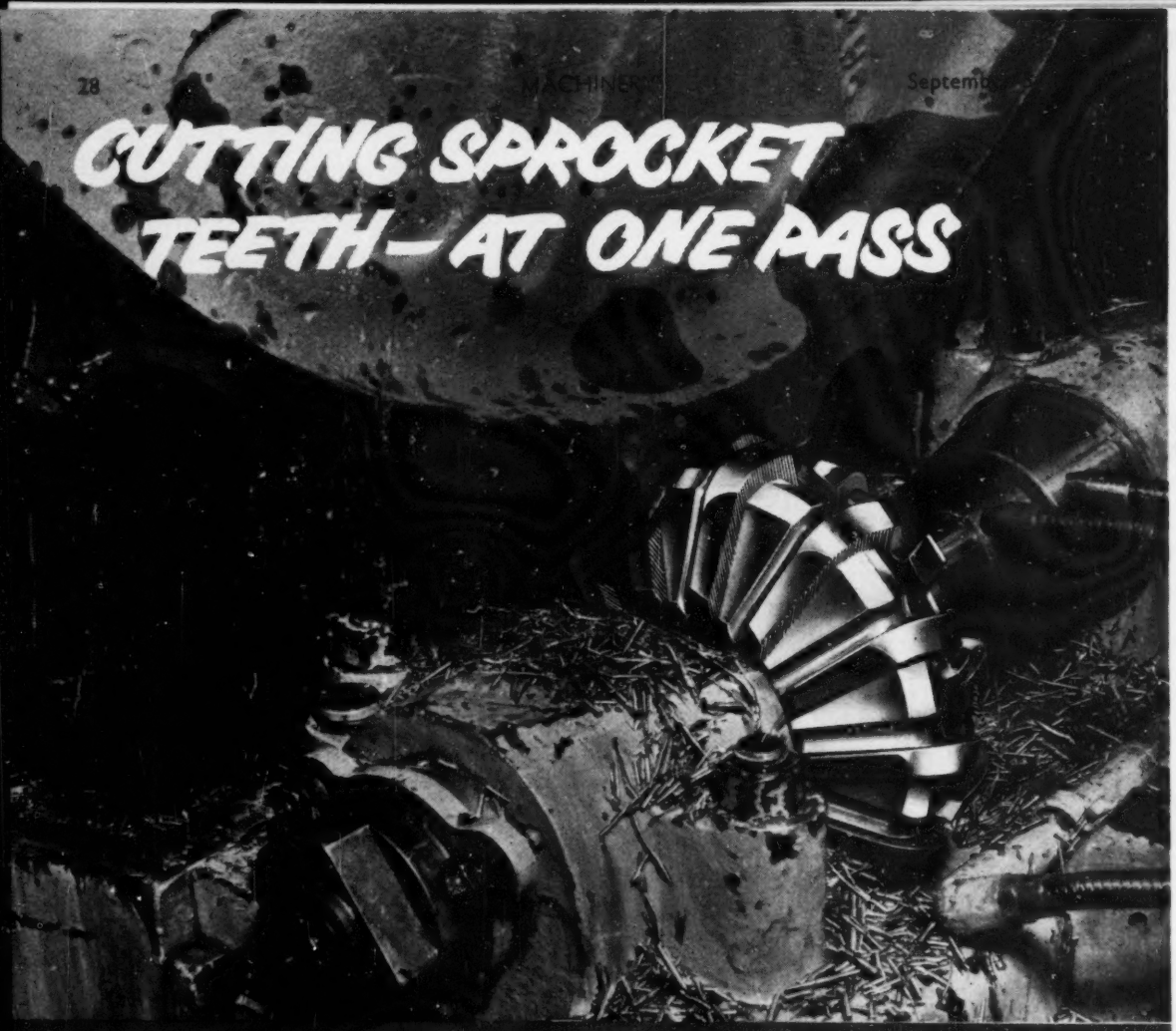
guaranteed setting accuracy ·0002 in.

Nominal travel of table	55 in.-1400 m.m.
Nominal spindle head travel	40 in.-1000 m.m.
Maximum distance from table-top to spindle nose	39½ in.-1000 mm.
18 spindle speeds 40-52-65-80-105-130-165-210-265-330-420-530-625-800-1000-1250-1600-2000	
Drilling capacity (in cast iron)	2½ in. - 60 mm.
Boring capacity	10 in.-250 mm.
GUARANTEED ACCURACY FOR ALL SETTINGS OF WORK-TABLE AND SPINDLE HEAD SADDLES	*0.0002 in.-0.005 mm.*



HYDROPTIC 8P

CUTTING SPROCKET TEETH—AT ONE PASS



AT F. H. LLOYD & CO. LTD., WEDNESBURY

Using GALTONA O-K special form interlocking cutters, as shown, F. H. Lloyd & Co. Ltd., Wednesbury, have achieved exceptional rates of output on cast steel sprockets. The pre-cast teeth are finished at one pass. Depth of cut is approximately ¼in., with a speed of 34 r.p.m. and feed of 1⅛in. per min. Cutter diameter is 9¼in., with a total overall width for the two cutters of 4¼in. If you need standard or special Cutters, our Tool Engineers will be only too pleased to submit recommendations on receipt of necessary details. Literature available on request.

O-K

SERRATED BLADE CUTTERS

Richard Lloyd Limited

GALTON HOUSE, ELMFIELD AVENUE, TYBURN, BIRMINGHAM, 24

Telephone: Ashfield 1801, Telegrams "Cogs, Birmingham"

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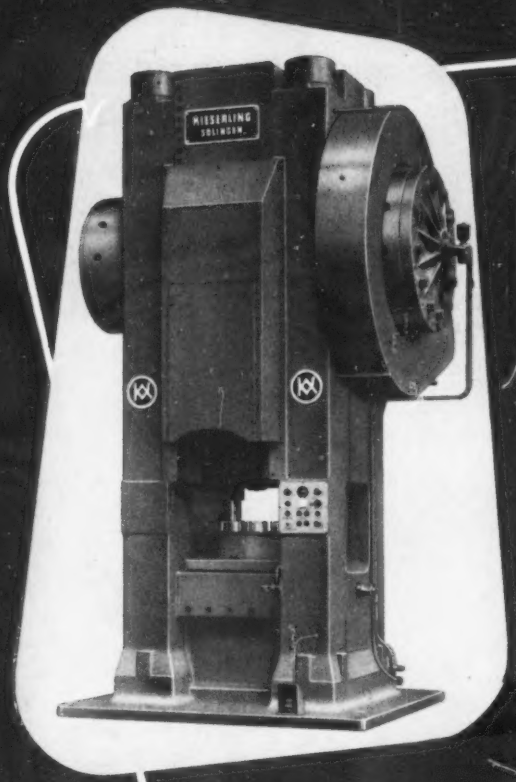

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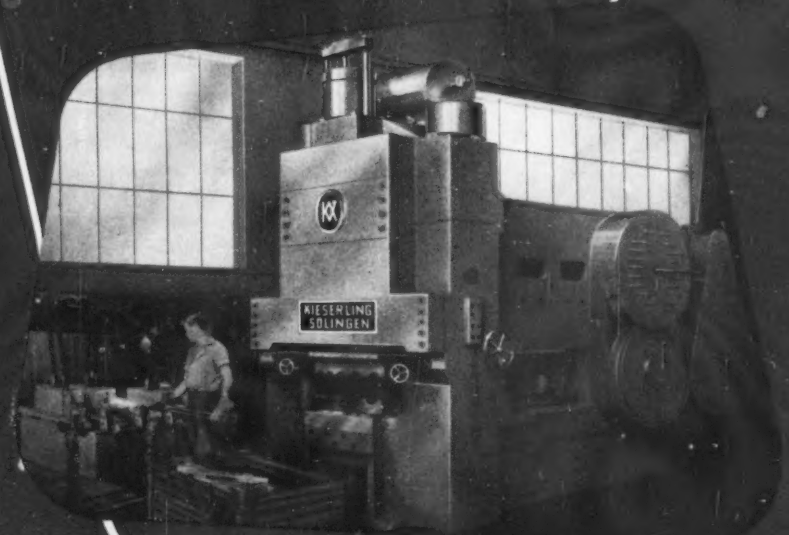
OUR MANUFACTURING PROGRAMME SECTION B

Special Machines for Forging Shops



British Agents: F. W. Aalbrech Ltd.
72 Victoria Road, London S.E.19

"How *do* you pronounce SCIAKY?"

One day I overheard Ma say that my pram was SKY-ACKY, SKI-ICKY, SHE-ACKY—welded, (How *do* you pronounce Sciaky?), and that I could bounce my bottom blue and I'd never break it (the pram).

Never break it indeed! Me with my Welfare-State-body and orange-juice-limbs and black-juice-vitamin-vitality! And me the naughty one! Me!

So I blew a few hostile bubbles, loosened my napkin and had a go at bashing the old boat to bits.

I bounced my bottom black and I broke it (my bottom).

Do you know, I had to visit the clinic every day for a fortnight with suspected displacement of the — well never mind.

At least I've proved that Sciacky-welded prams are unbashable.

SCIAKY

SCIAKY ELECTRIC WELDING MACHINES LIMITED. FALMOUTH ROAD, SLOUGH, BUCKS, ENGLAND. TEL: SLOUGH 25551 (10 LINES) CABLES: SCIAKYWELD, SLOUGH

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AMERICAN STANDARD CAMLOCK SPINDLE FLANGE.....

Dean Smith & Grace
KEIGHLEY LIMITED ENGLAND
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...featured on all D.S.G. lathes

- PERMANENT ACCURACY
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- RIGID MOUNTING
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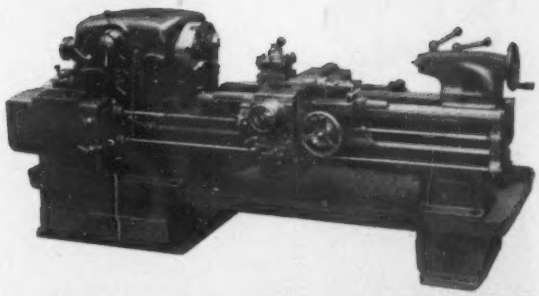

17" swing ENGINE LATHE

Note the spindle bore size, and oversize Camlock flange on these types:

13" swing	D1-6"	1⅝" hole
17" swing	D1-8"	2⅝" hole
21" swing	D1-11"	3⅝" hole
25" swing	D1-11"	4⅛" hole
30" swing	D1-11"	4⅝" hole

We manufacture....

13" to 30" SWING ENGINE LATHES
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TOOLROOM LATHES

DSG

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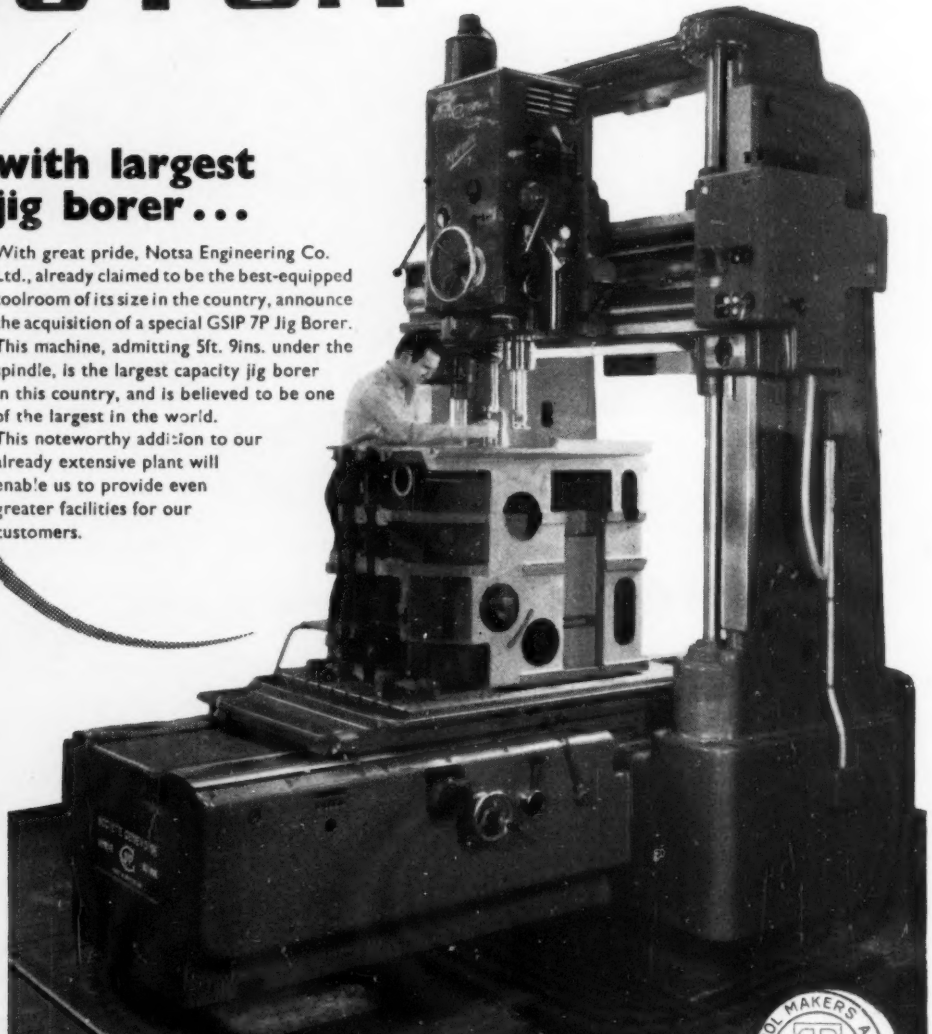
NOTSA *leads again!*

with largest jig borer...

With great pride, Notsa Engineering Co. Ltd., already claimed to be the best-equipped toolroom of its size in the country, announce the acquisition of a special GSIP 7P Jig Borer. This machine, admitting 5ft. 9ins. under the spindle, is the largest capacity jig borer in this country, and is believed to be one of the largest in the world. This noteworthy addition to our already extensive plant will enable us to provide even greater facilities for our customers.



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NOTSA ENGINEERING COMPANY LTD

LODGE WORKS · ASTON-ON-TRENT Near DERBY

Telephone: SHARDLOW 295 & 296 · *Telegrams:* NOTSA, ASTON-ON-TRENT, DERBY

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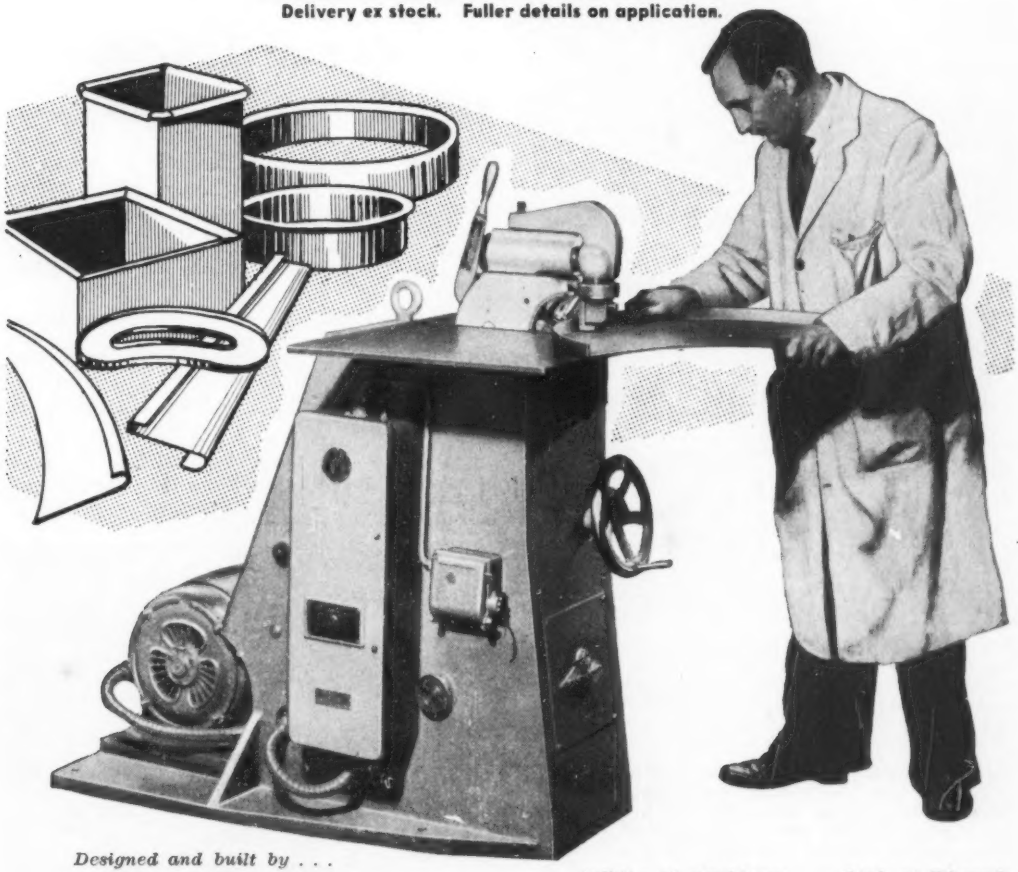
The BESCO H S SHEET METAL FORMING & FLANGING MACHINE

makes that nightmare job of flanging and forming irregularly shaped sheet metal just another easy and accurate operation for the semi-skilled man, taking the place of the old hand methods. Flanges externally and internally: forms, with the necessary tools, plain flanges; return bends; off-set, flared, large radius and half-round flanges, or wires and false wires the edges of sheet metal.

Maximum height of flange, 1⅞ in.
Maximum thickness handled. 12 S.W.G. mild steel.
Delivery ex stock. Fuller details on application.



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talking of machinery . . . think of Edwards

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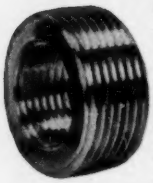
AT CANADIAN PRATT AND WHITNEY AIRCRAFT

ALMCO

barrel finishing SAVES 97% on deburring and finishing of spark plug bushings



● **SAVES 9d. ON EACH BUSHING**—Deburring and finishing threaded spark plug bushings like the one shown at the left, formerly cost £37.4.0 per thousand when CP & W used speed lathes, portable power tools and other hand methods.

After installing two ALMCO DB-200 Supersheen units, records showed a cost cut of 97%. This equipment turns out 1,000 bushings in 45 minutes, releases grinders and finishers to other duties. Cost reports showed:

£37.4.0	cost per thousand with power tools.
£ 1.1.0	cost per thousand with 2 ALMCO barrels.
£36.3.0	Savings per thousand pieces.

This year CP & W will process 24,000 spark plug bushings, with a total savings of £867.10.0 on this one part alone.

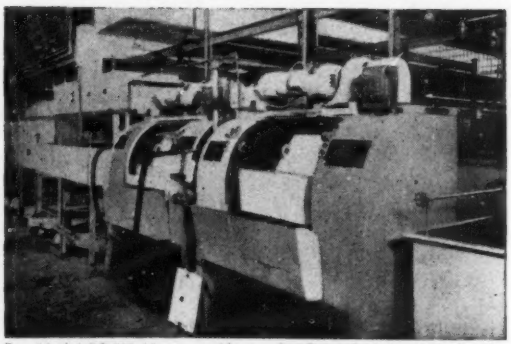
PRACTICALLY ELIMINATES REJECTS—Before installing controlled-type barrel finishing, parts inspectors returned for re-work an average of 125 bushings out of every 1,000 (12½%). With Almco Supersheen equipment and processes, these parts are now finished to a degree of uniformity that is virtually free of rejects.

CUTS DEBURRING AND FINISHING COSTS £867.10.0—Threaded spark plug bushings used in famous Pratt & Whitney aircraft engines will be deburred and finished for £867.10.0 less this year with Almco equipment and processes. Maurice Harrison, Supervisor of Process Planning, shows the small part on which this saving will be made.

DESIGNED FOR MANY METAL FINISHING OPERATIONS—In addition to deburring and finishing, ALMCO equipment and processes are used for descaling, degreasing, grinding, burnishing, work-hardening, rust-inhibiting, polishing, etc.

ALMCO SUPERSHEEN materials, equipment and processes have been developed by engineers and technicians fully trained in all the intricate variables of modern barrel finishing applications.

FREE SAMPLE PROCESSING. ALMCO has ample facilities for running sample parts. Send sample components, with your specifications to our Process Laboratory, your enquiry will be handled promptly. You'll get a complete report on where you can save deburring and finishing costs, improve product quality and appearance, the method and machine best suited for your operation. GET THE FACTS TO-DAY.



Two Model DB-200 Almco machines, using Supersheen bonded abrasive chips and compounds, deburr and polish 1,000 spark plug bushings in 45 minutes at Canadian Pratt and Whitney.

ALMCO Supersheen

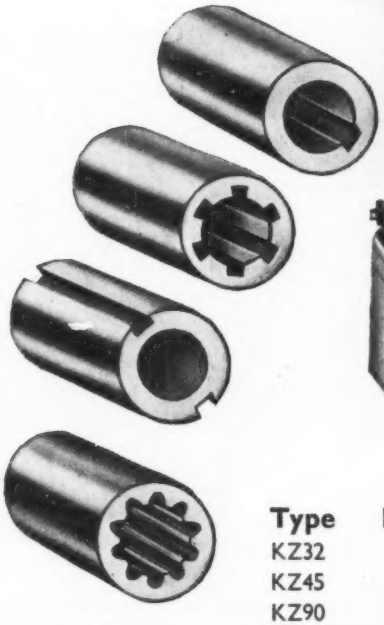
BURY MEAD WORKS · HITCHIN · HERTS

Telephone: Hitchin 3669

HOLLAND (Rotterdam) N.V. Technische Handelsonderneming "Carborundum-Aloxite" : **BELGIUM & LUXEMBURG (Bruxelles)** Tecnimetal Societe Anonyme : **SWEDEN (Stockholm)** Trumlingsaktiebolaget : **SWITZERLAND (St. Gallen)** L. Kellenberger & Co. : **SOUTH AFRICA (Johannesburg)** Barry Colne & Co. (Pty.) Ltd. : **AUSTRALIA & NEW ZEALAND (Melbourne)** Hardie Trading Ltd.

FRÖMAG

HYDRAULIC KEYSEATING MACHINES



Type	Keyway Width	Max. Stroke
KZ32	$\frac{1}{8}$" - $1\frac{1}{4}$"	$10\frac{1}{2}$"
KZ45	$\frac{1}{8}$" - $1\frac{3}{4}$"	$13\frac{3}{4}$"
KZ90	$\frac{1}{8}$" - $3\frac{1}{2}$"	$21\frac{1}{2}$" - 50"
KZ125	$\frac{7}{8}$" - 5"	59"

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PROPRIETORS **COMPANY** S. GUITERMAN & CO. Ltd

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c2

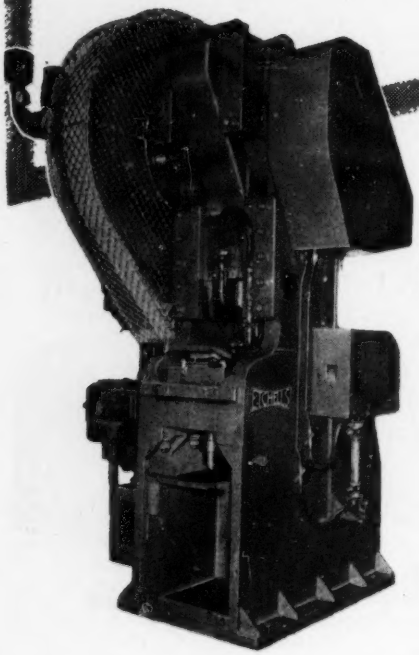
Two minds with but a single thought —

HIGH PRODUCTION

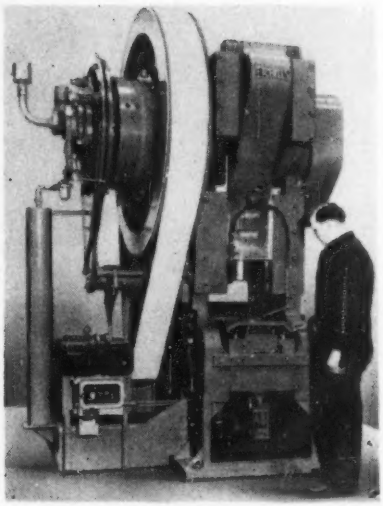
ETCHELLS

FORGING MACHINES WITH

The STEPHENS Miraclo NYLON BELT WITH CHROME LEATHER DRIVING FACE



No. 2 Etchells Vertical Forging Machine—write for details.



Brochure 103 tells you HOW TO DESIGN A MIRACLO DRIVE.

Etchells and Miraclo are both renowned for the high production they give. The Etchells No. 0 forging machine produces 20 forgings per minute with hand-fed blanks — no wonder it has aroused much interest in the nut and bolt trade.

Miraclo, the bonded nylon and chrome leather belt, is fitted to all Etchells machines because of its qualities of no slip, stretch or loss of power and because Miraclo has long life and needs no maintenance. Remember, for faster forgings it's Etchells and for the best drive on all machines fit Miraclo.

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STEPHENS BELTING CO. LTD.
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S78

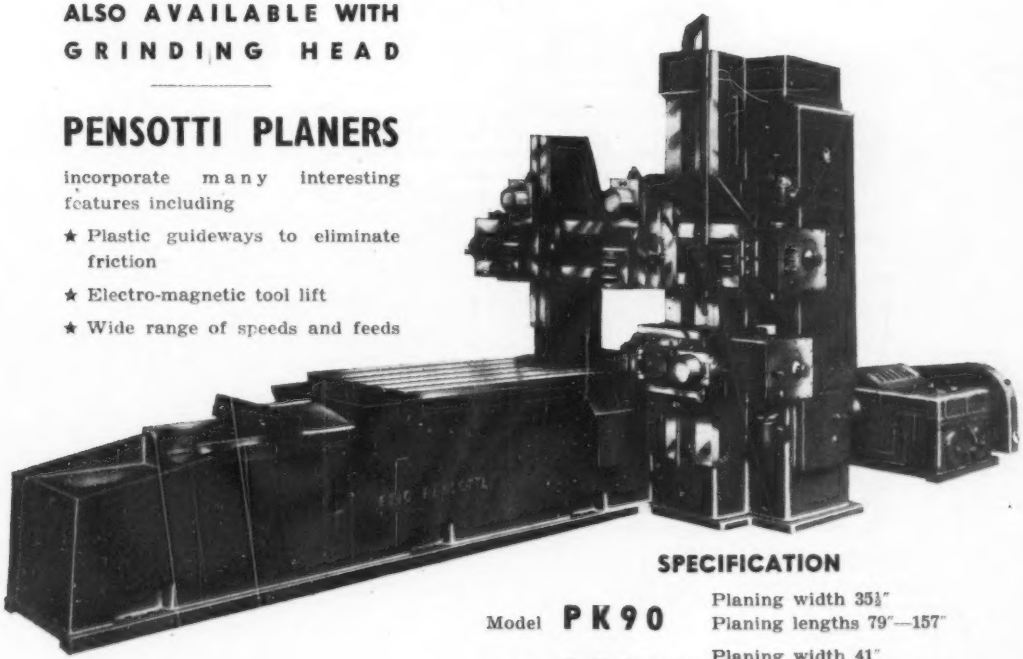
PENSOTTI PLANING & MILLING MACHINES

ALSO AVAILABLE WITH GRINDING HEAD

PENSOTTI PLANERS

incorporate many interesting features including

- ★ Plastic guideways to eliminate friction
- ★ Electro-magnetic tool lift
- ★ Wide range of speeds and feeds



SPECIFICATION

Model	**PK90**	Planing width 35½" Planing lengths 79"—157"
Model	**PK105**	Planing width 41" Planing lengths 78"—197"
Model	**PK125**	Planing width 49" Planing lengths 98"—236"

3 SIZES AVAILABLE

NRP 2164

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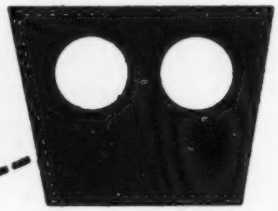
the GROMMET story



4 good reasons for fitting BTR High Test **V-BELTS**

1 **HIGHER HORSEPOWER**

Grommet construction makes the most efficient use of high tensile cords to produce the strongest V-belts yet made. For grommet construction ensures that *all* the cords of a belt share the load *equally*—which is the condition for maximum transmitting efficiency. Furthermore, a grommet, being an endless loop of high tensile cords, has no joints to weaken the belt, no overlapping sections to stiffen it.

2 **MORE GRIPPING POWER**

Grommet construction ensures that the belt exerts full driving grip on the walls of the pulley groove, for there are no central cords to dip and 'dish' the belt, pulling it away from the walls under load. This extra driving grip allows heavier loads and prevents belt slip.

3 **MORE OUTPUT FOR ELECTRICITY CONSUMED**

Despite its superior strength, a grommet is the most flexible V-belt load carrying device yet developed. Thus the belt runs cool and absorbs minimum energy in flexing around the pulleys. This saving in power appears in extra pay-load for electricity consumed.

4 **LONGER BELT LIFE**

Operating with a higher safety factor than ordinary V-belts, BTR grommet V-belts last longer because they are stronger and also because being so flexible they are subject to little strain in flexing round the pulleys.

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ENGINEERS IN RUBBER

BTR HIGH TEST GROMMET V-BELTS

Patented in Great Britain by BTR Patent No. 567406

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D1359

The most versatile multi-cut Lathe

HERBERT-SMALLPEICE

with a choice of . . .

- **THREE HEADSTOCKS**
- **MOTOR**
- **SPEED RANGE**
- **MANUAL OR AUTOMATIC CYCLE**
- **REAR SLIDES**
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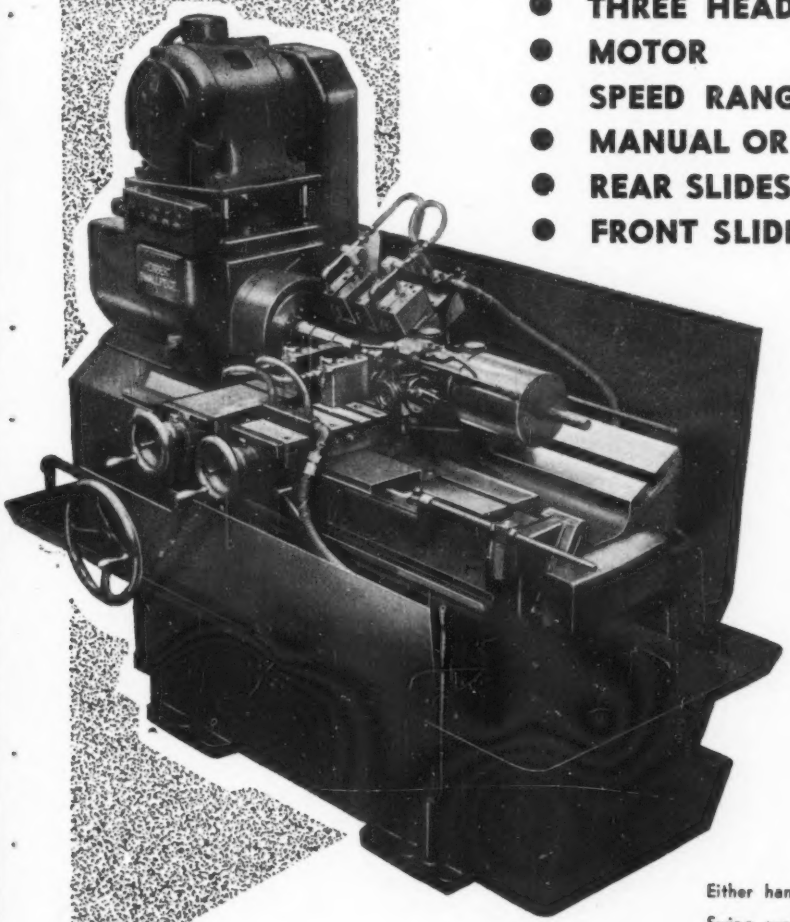

A unit-constructed machine which enables tooling for wide variety of long and short components to be arranged quickly in any combination by means of slides and attachments.

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Swing over bed ... ... 12"

Admits between centres ... ... 29"

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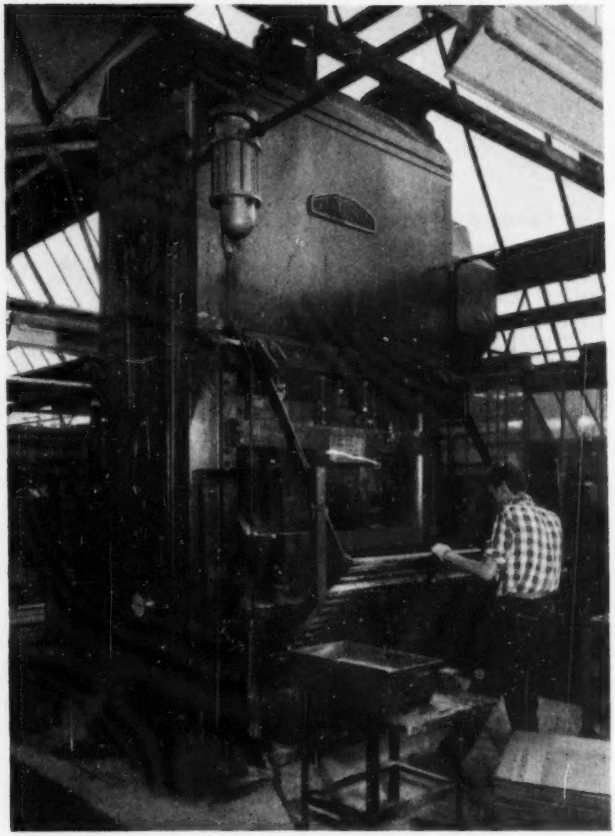

This photograph shows one of our 200-ton Two-Point Presses in the Works of Messrs. Belling & Co. Ltd., by whose kind permission it is shown. The machine is used on a range of panels and other components for our clients' well-known electric cookers, fires, etc.

craig & donald presses

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A Proved JIG BORER

-at an attractive price!

THE MODEL VL600 aba

Optics by Leitz
Power Feed to Spindle
Covered ways

Large Selection of Extra Equipment Available

Brief Specification

Area of table	16" x 26"
Longitudinal Travel of table	26"
Cross Travel of table	17"
Number of spindle speeds, geometric progression ratio 1.41 ...	12
Spindle Speeds	31–1500 r.p.m.
8 Power feeds	·0015"–·017" p. rev.

12 page Booklet will be sent on application to Sole Agent!

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MACHINE TOOL CO. LTD.

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- **Eliminates Hand Feeding— one operator to several machines.**
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- **Saves on Stock costs—utilises coil stock instead of strip.**

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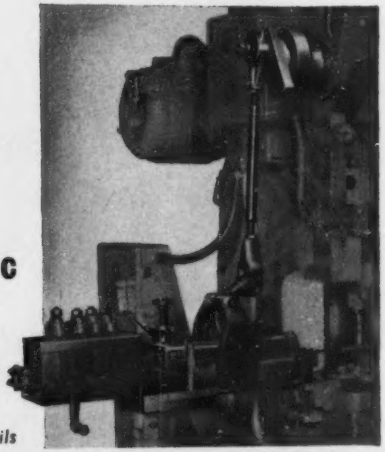

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- **Eliminates location of keyways.**
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- **Saves time in shifting feed from press to press.**

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PR13

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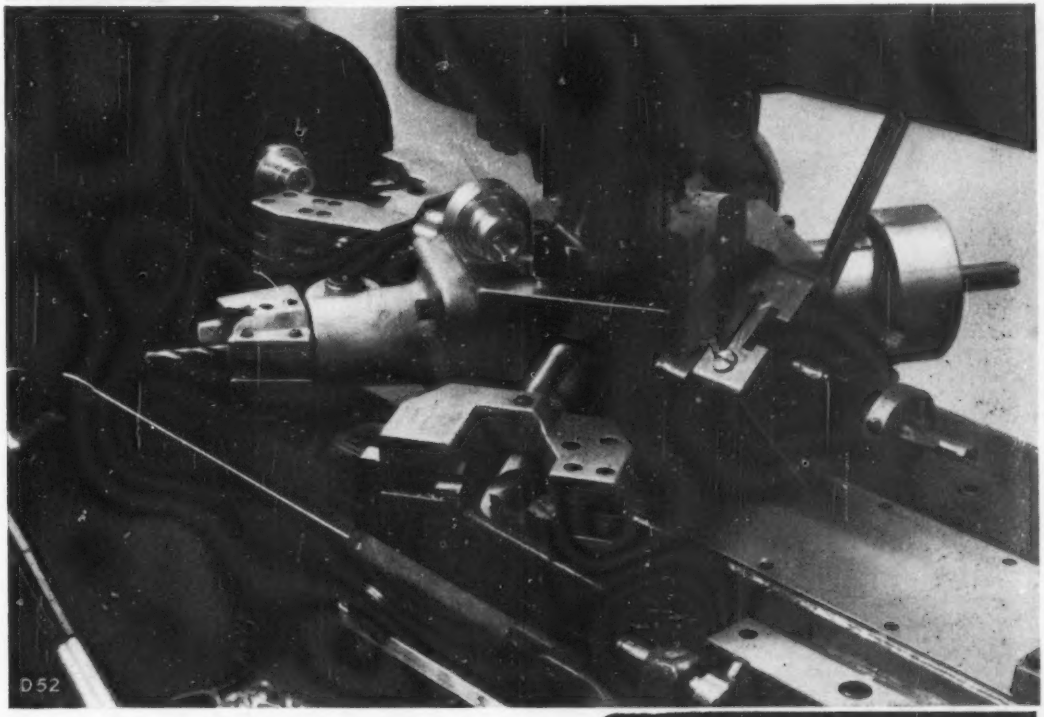
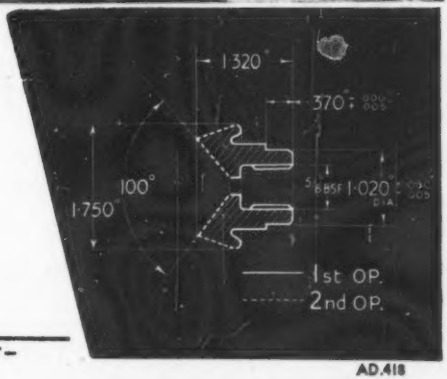
No. 2 Flashcap Lathe for efficient high production of non-ferrous threaded components requiring frequent spindle reversals



Magnesium alloy component shown is machined from blanks sawn from the bar, in two operations, on a Herbert Flashcap Lathe. Floor-to-floor times —29 seconds (1st op.), 11 seconds (2nd op.).

Now available for **Early Delivery**



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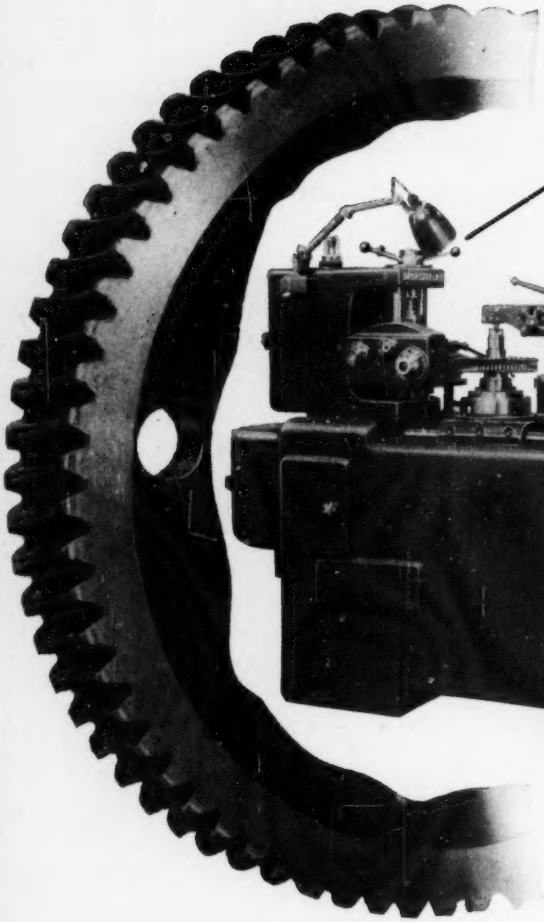

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Capacity Max Centre Distance Between Hob & Work 8″
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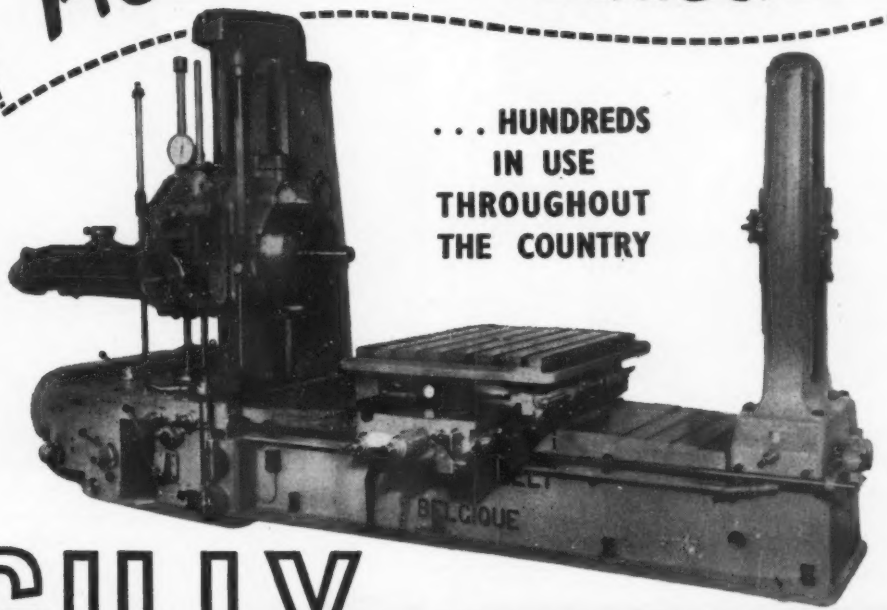

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Hundreds of these machines, all over the country, are meeting the most exacting needs for all types of production. They feature ample power—wide range of speeds and feeds—built in swivelling table—continuous automatic facing head—vernier scales and fine setting device—telescopic bed covers—oversize table and extended cross traverse—extended vertical traverse.

TABLE TYPE MACHINES	AFMF 65	*AFMF 80	*AFMF 100	AFMF 130	AFMF 160
Spindle diameter	2¾in.	3⅛in.	4in.	5¼in.	6½in.
Facing capacity	19⅝in.	29½in.	39⅜in.	49½in.	57in.
Speed range	10-1,250 r.p.m.	9-1,100 r.p.m.	5-975 r.p.m	4-700 r.p.m.	2-9-500 r.p.m.
Table surface	28 x 35½in.	35½ x 44in.	43⅜ x 51½in.	55½ x 63in.	63 x 70⅝in.

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CAP.
0"—⅛"
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Optical Glass

★ **MODEL 3/1**
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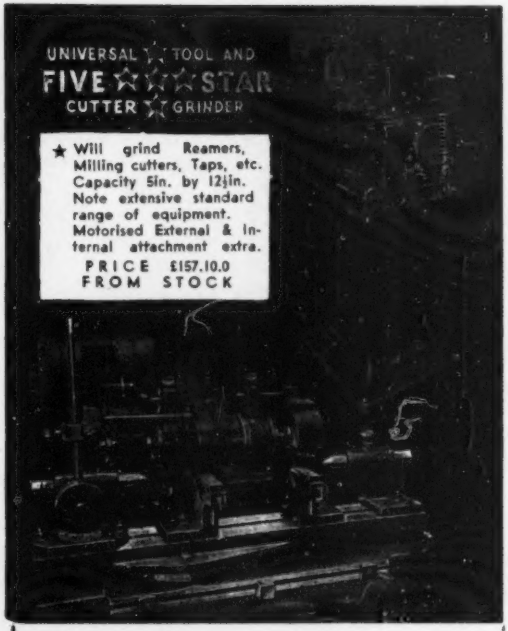

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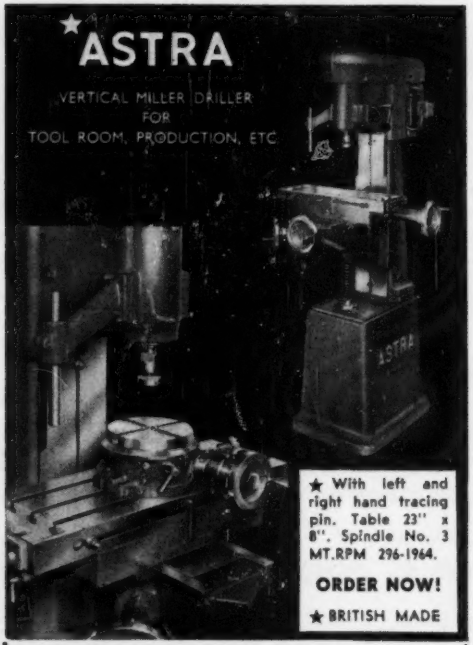

★ With left and right hand tracing pin. Table 23" x 8". Spindle No. 3 MT.RPM 296-1964.

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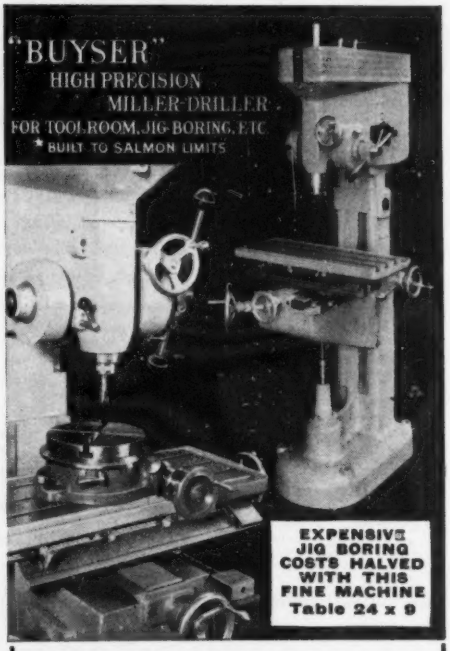

EXPENSIVE JIG BORING COSTS HALVED WITH THIS FINE MACHINE
Table 24 x 9

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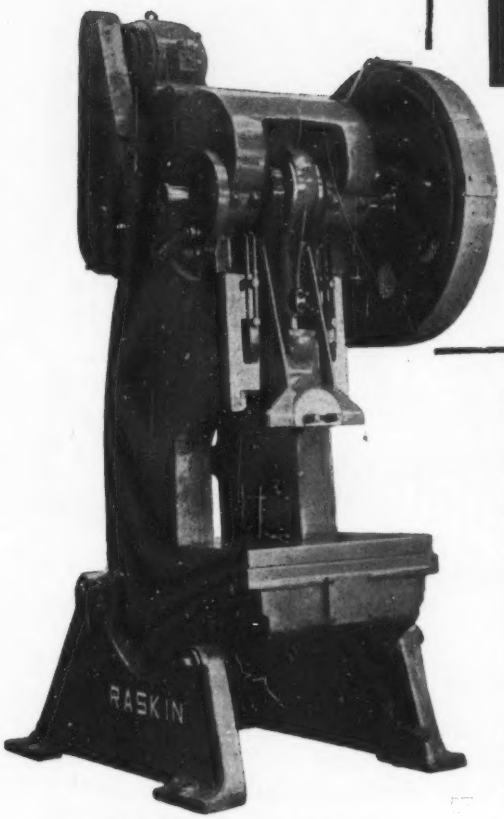

Model	Capacity in Tons	Adj. of Stroke	Bed Area
6.1 Ungeared	6	$\frac{3}{8}$"–1 $\frac{3}{16}$"	19$\frac{1}{2}$" x 7$\frac{1}{4}$"
14.1N ,,	14	$\frac{3}{8}$"–2$\frac{3}{8}$"	15$\frac{3}{4}$" x 10"
22.1B ,,	22	$\frac{1}{2}$"–2 $\frac{13}{16}$"	23$\frac{1}{2}$" x 15$\frac{3}{4}$"
35.1B ,,	35	$\frac{3}{4}$"–3 $\frac{1}{8}$"	25$\frac{1}{2}$" x 16$\frac{3}{4}$"
45.1B ,,	45	$\frac{1}{2}$"–5"	28" x 18$\frac{3}{4}$"
75.1B ,,	75	$\frac{1}{2}$"–5"	35$\frac{1}{2}$" x 23$\frac{1}{2}$"
45.1BA Geared	45	$\frac{1}{2}$"–5"	28" x 18$\frac{3}{4}$"
75.1BA ,,	75	$\frac{1}{2}$"–5"	35$\frac{1}{2}$" x 23$\frac{1}{2}$"
100.1H ,,	100	$\frac{3}{4}$"–5 $\frac{1}{2}$"	39$\frac{1}{2}$" x 27$\frac{1}{2}$"
120.1H ,,	120	$\frac{3}{4}$"–5 $\frac{1}{2}$"	39$\frac{1}{2}$" x 27$\frac{1}{2}$"
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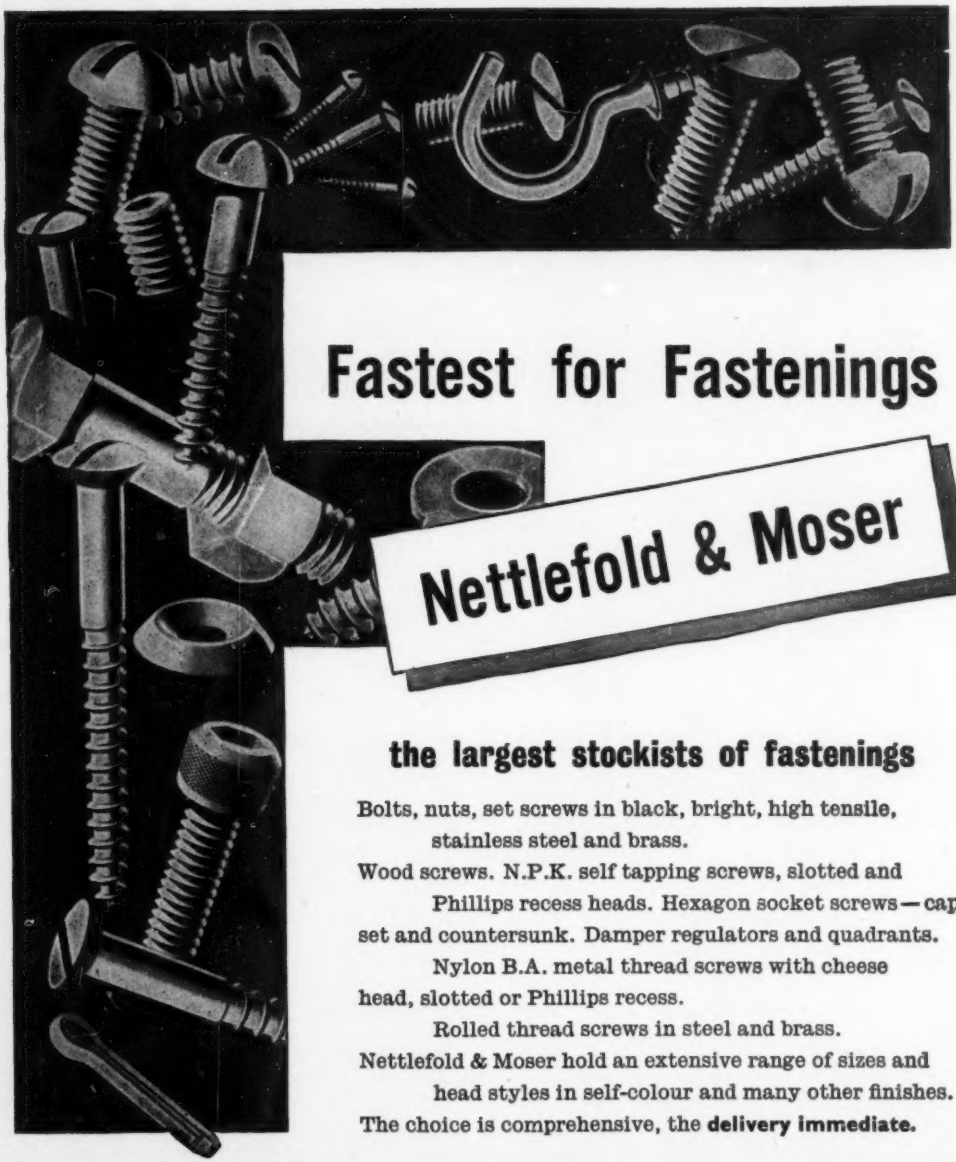

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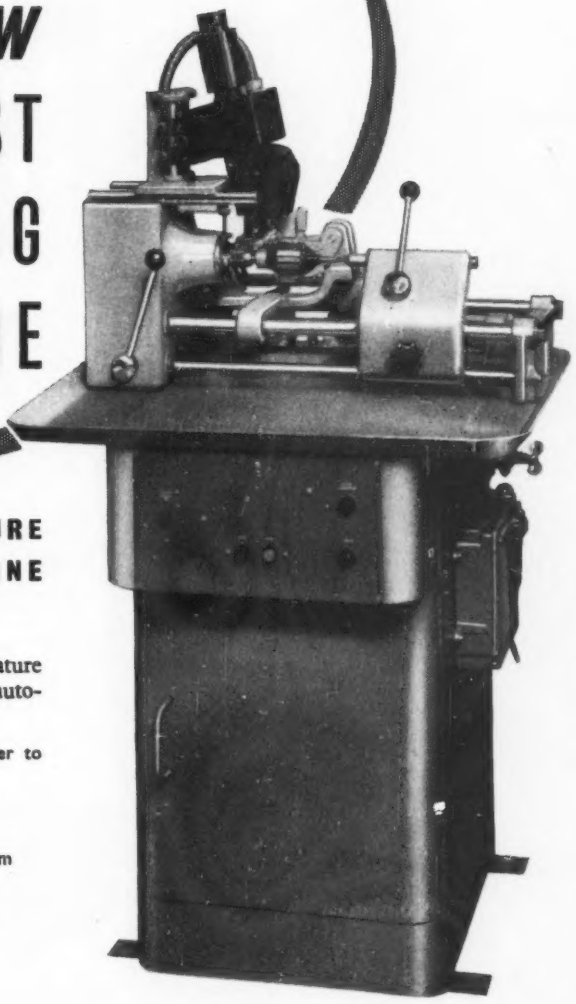
NEW COST CUTTING MACHINE



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- ✳ Automatic alignment of slot with cutter to within 0.002 in.
- ✳ Operating time cycle 1 second per slot
- ✳ Automatic counting
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For armatures of the following sizes:

COMMUTATOR	Diameter	0.5 - 2 in.
	Length	0.25 - 2.25 in.
ROTOR	Maximum diameter	4 in.
	Maximum length	9 in.
	Maximum weight	25 lb.
	Number of slots	9 - 125

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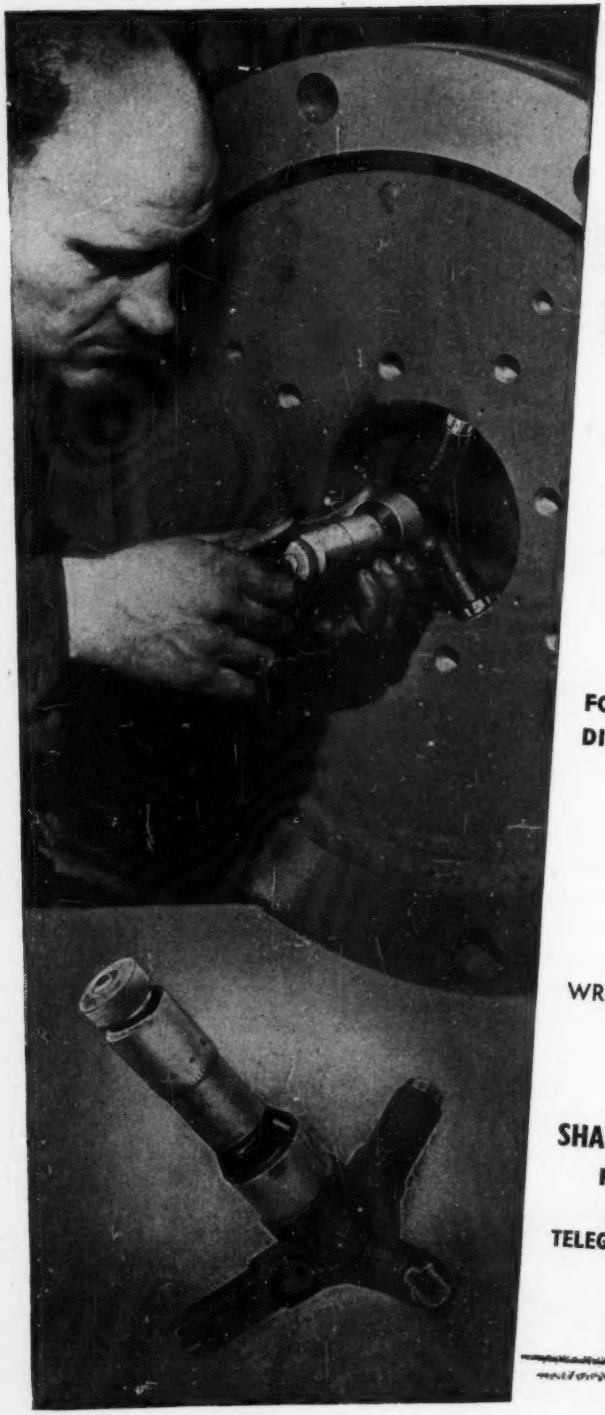

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BRITISH PATENT 637034

FOR ABSOLUTE PRECISION ON DIRECT READING OF INTERNAL MEASUREMENTS

COMPLETE RANGE FROM 0·275 in. TO 8 INS. DIA.

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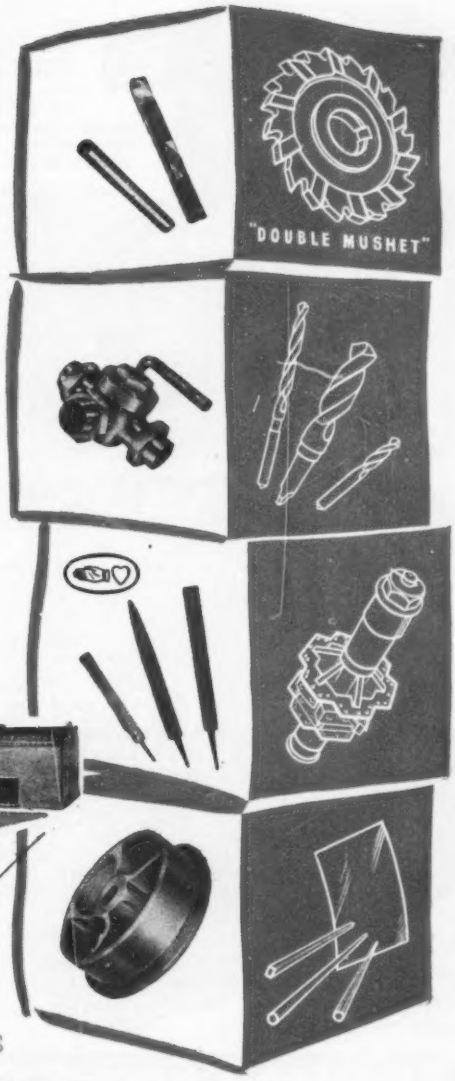

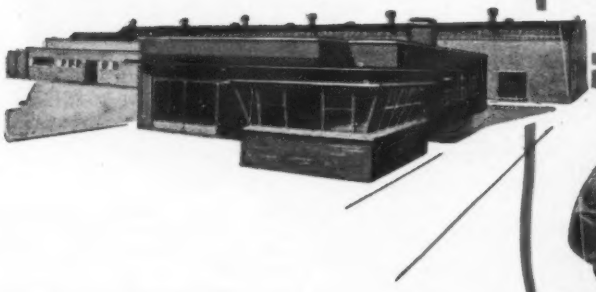

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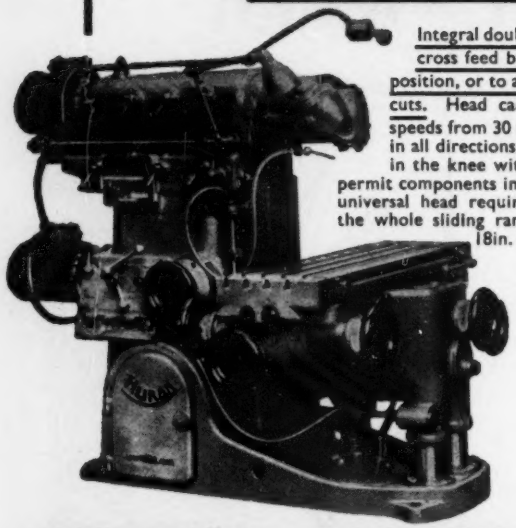
ANGULAR COMPOUND HORIZONTAL VERTICAL

HURON SUPER UNIVERSAL MILLERS

SLIDING RAM GIVES 27½in. AUTO CROSS FEED



Integral double swivelling universal head provided with 27½in. automatic cross feed by the sliding ram, can be set to the horizontal or vertical position, or to any angle instantaneously—permits the heaviest production cuts. Head can be retracted completely from table line. 27 spindle speeds from 30 to 2,066 r.p.m. 27 feeds from 1/2in. to 30in. Rapid traverses in all directions. All operating controls duplicated. Table slides directly in the knee without cross movement or swivel. Double guides of knee permit components in excess of 1½ tons to be machined. The double swivelling universal head requires an opening of only 14in. to enter work pieces and the whole sliding ram with its 27½in. automatic cross movement needs only 18in. clearance.

Type	Table	Automatic Feeds Long	Cross	Vert.
KU4	56 3/4in. × 15½in.	43½in.	27½in.	19½in.
KU5	64 3/4in. × 15½in.	51½in.	27½in.	19½in.
KU6	78½in. × 16½in.	59in.	27½in.	19½in.
L7	157in. × 39in.	118in.	27½in.	39½in.

Type 'L' Open-side Traversing Head Universal Miller will mill, bore, slot and drill the largest work-pieces at one setting.
The unique design permits greatest variety of operation on large work-pieces; the component remains stationary on the large work-table. Upright slides full length of base table, and the sliding ram moves vertically and horizontally.

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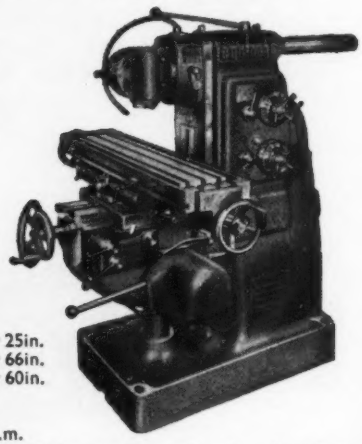

Table surface 43 3/16in. by 9½in. or 47½in. by 10½in. Auto long. feed, 26½in. or 30½in. Auto vert. feed, 15½in. or 18½in. Auto cross feed 9¼. Rapid traverse in all directions. No. 40 International taper for main spindle, universal head, and rotary table. Direct reading dial change for speeds and feeds. All parts subject to wear hardened and ground and completely interchangeable. Built to closest tolerances. Spindle speeds 21 to 1,600 r.p.m. Twin overarms. Separate motor for rapid traverses.

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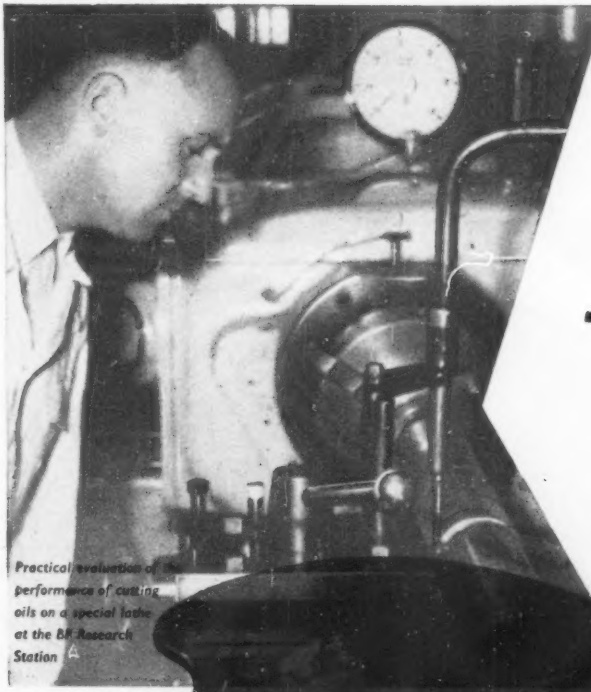

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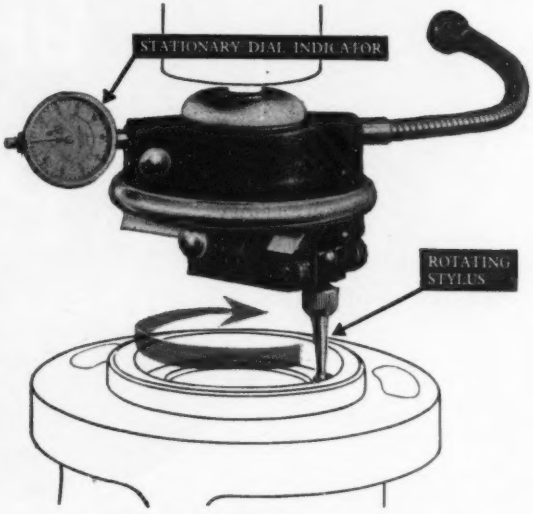

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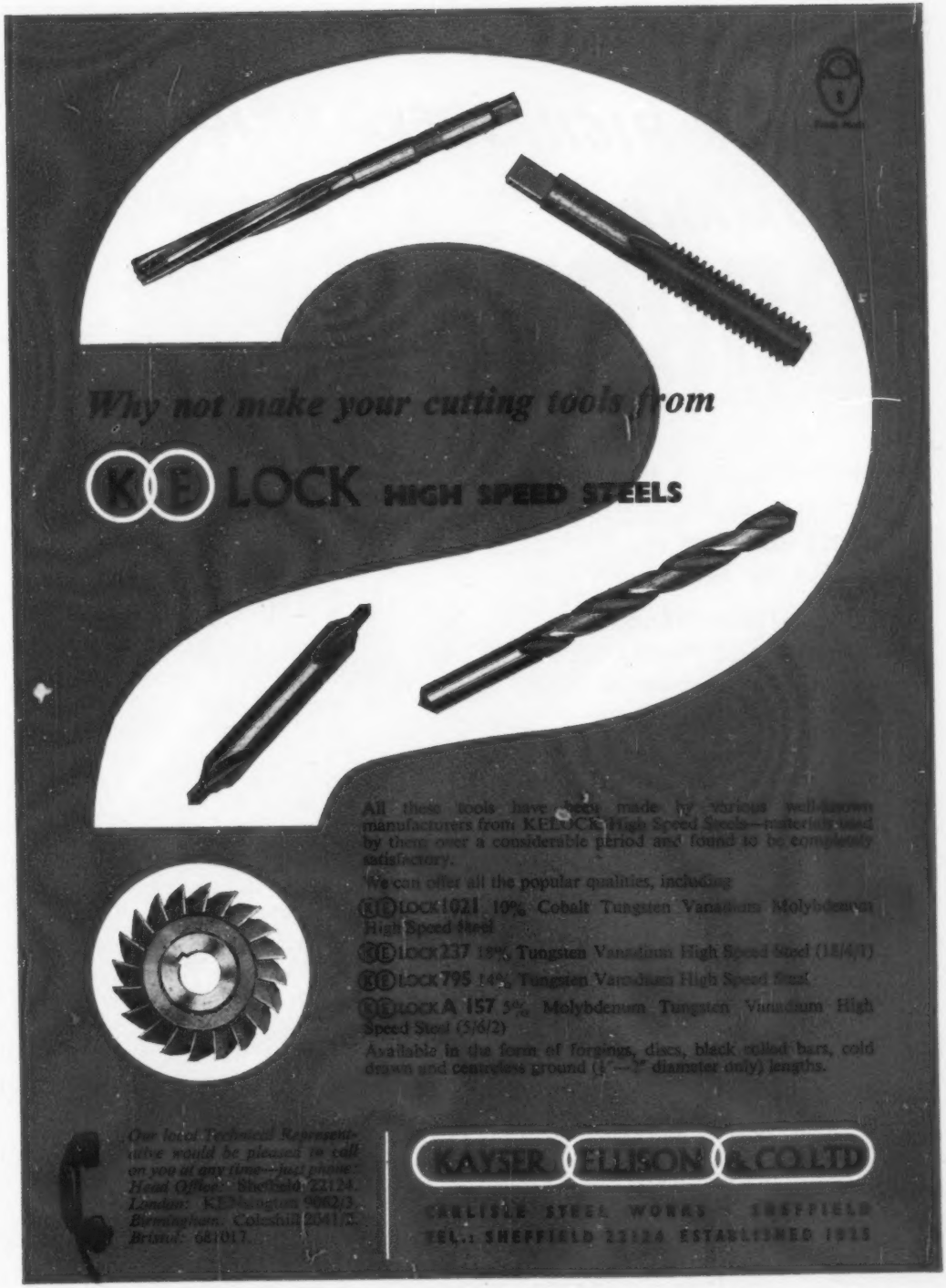
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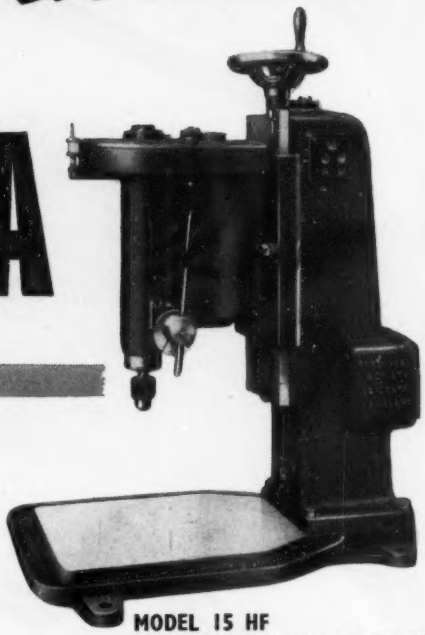

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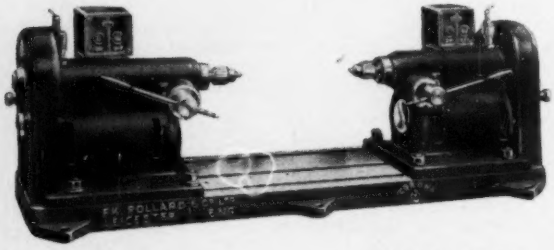

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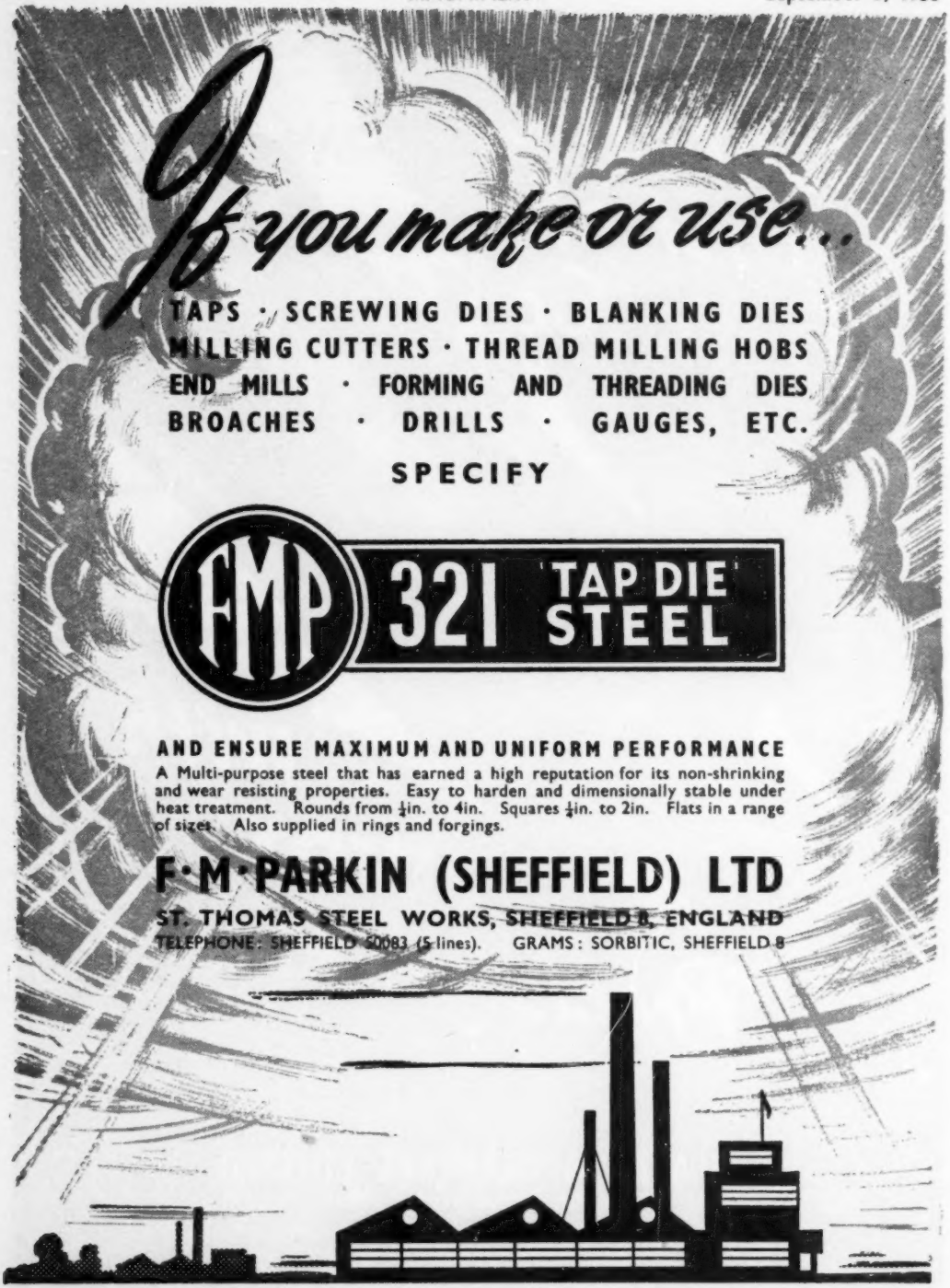
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CAPACITY

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Number of spindles	.. 10

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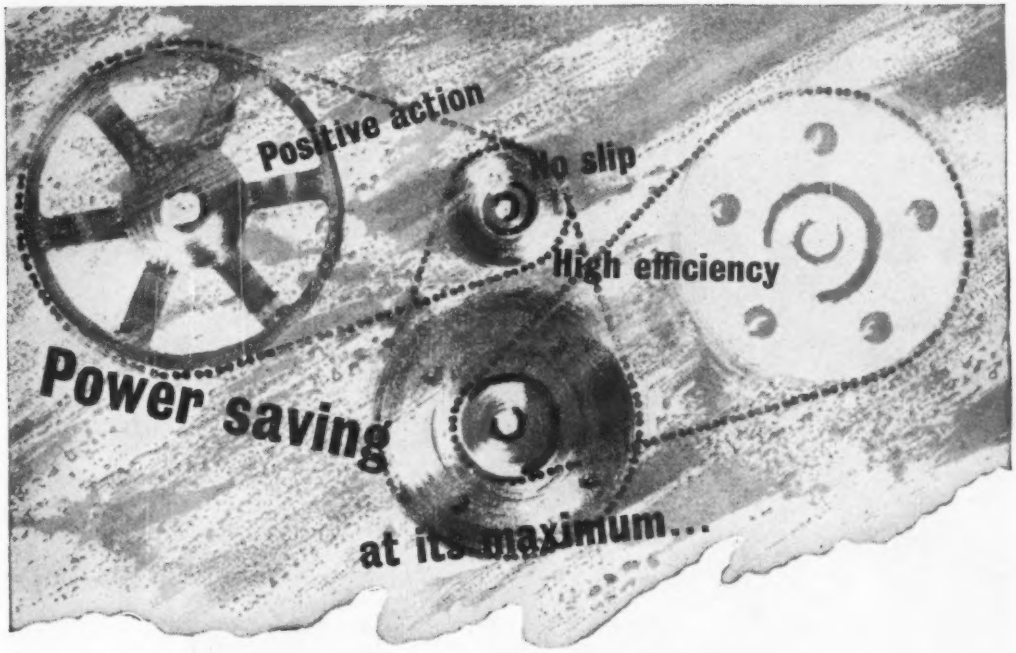

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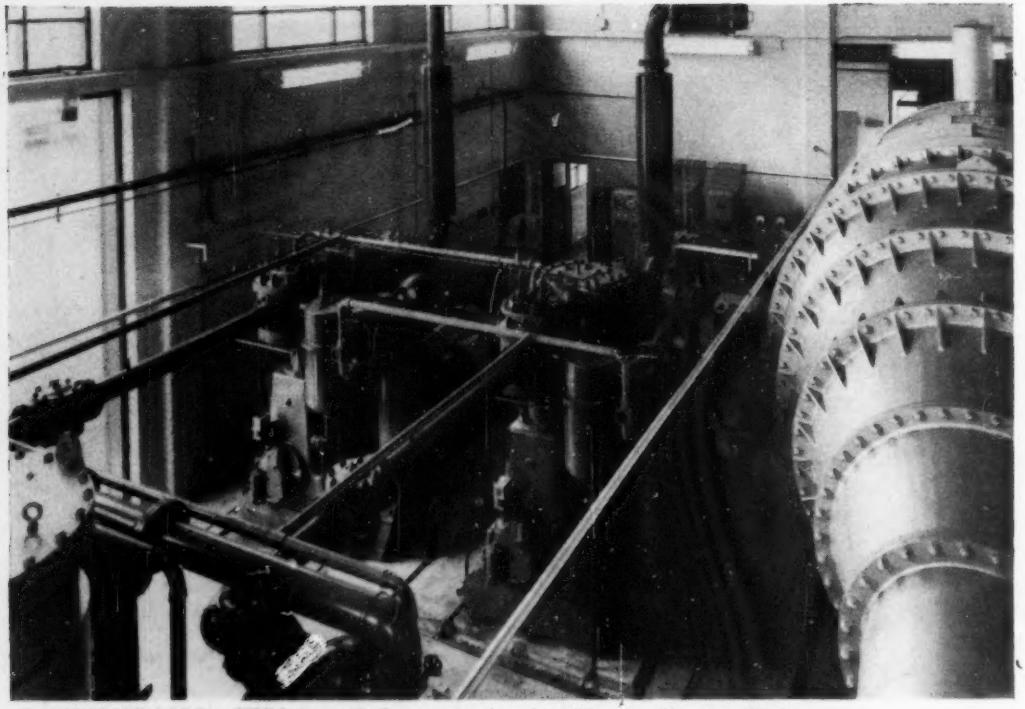

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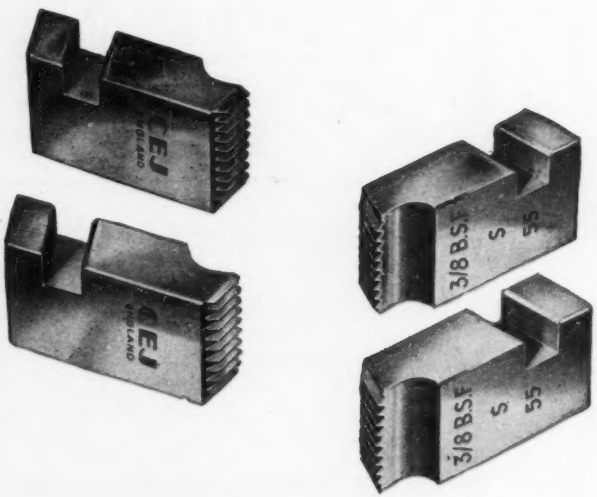

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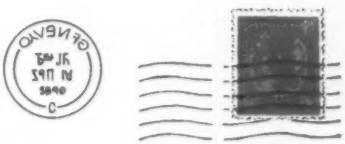

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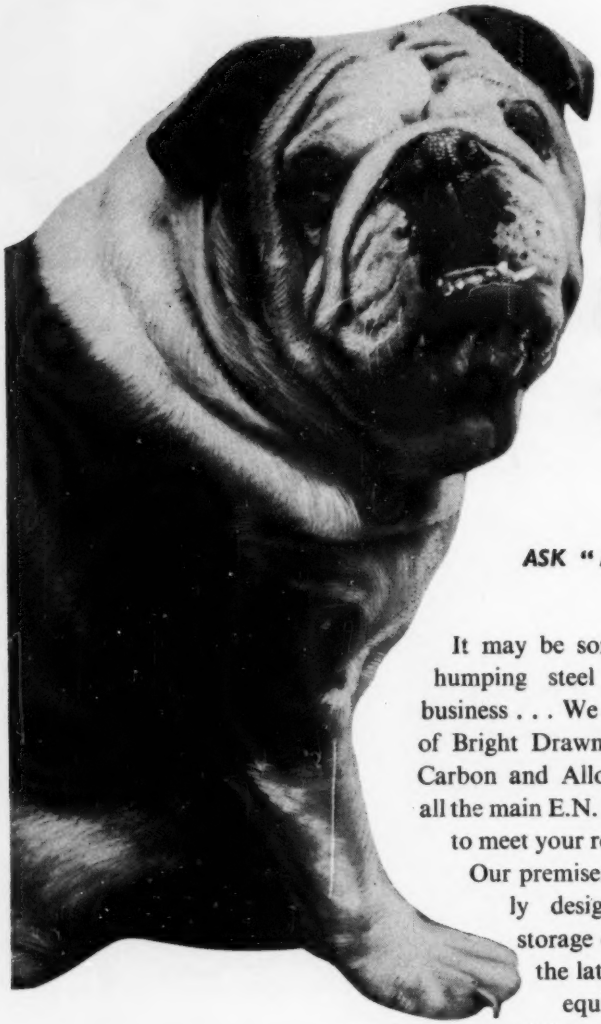

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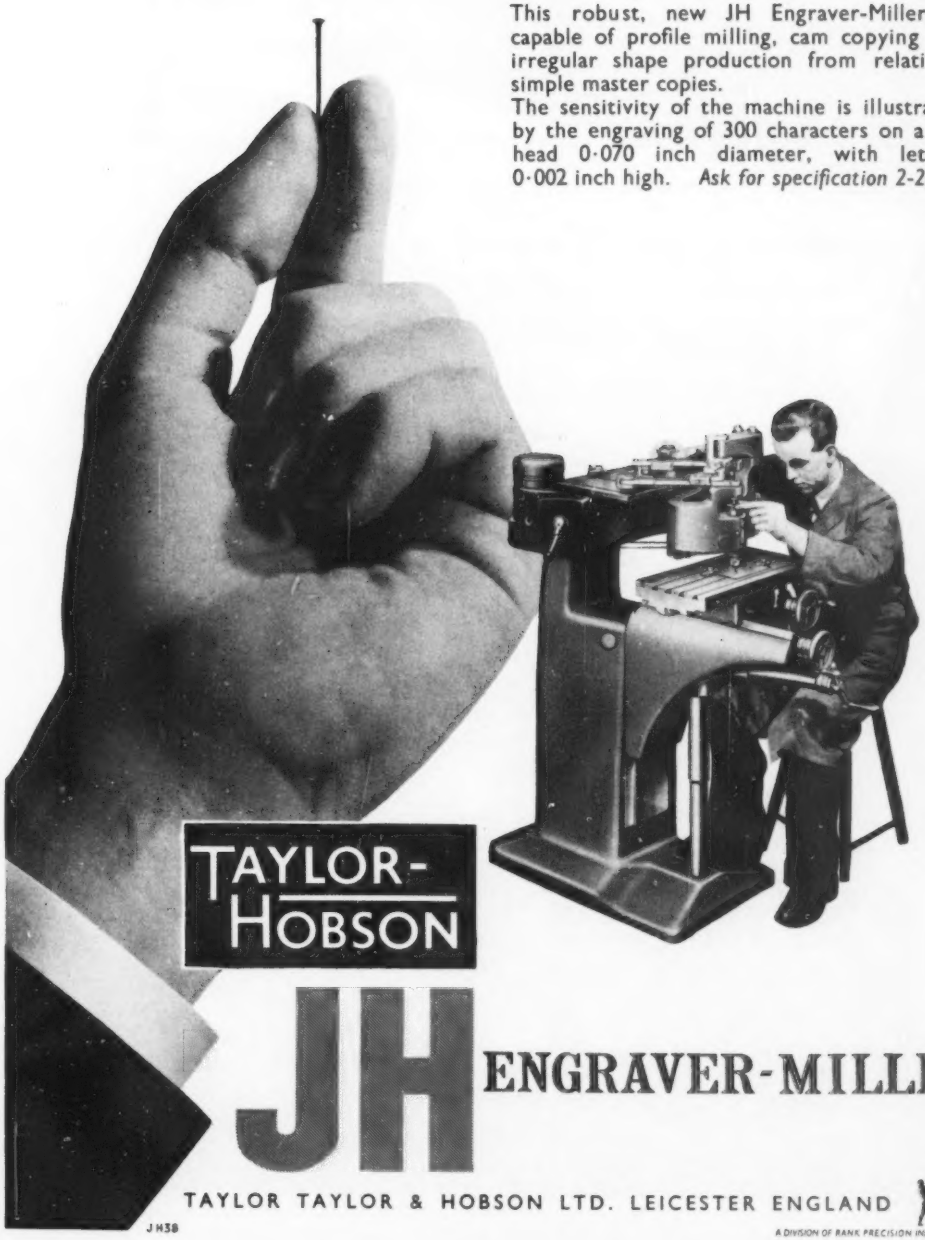

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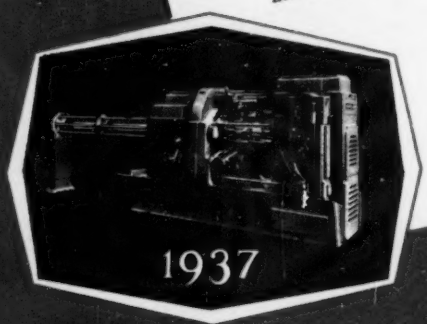
As you know, since its installation the Raleigh Company have ordered and installed a considerable number of these machines to meet the continued expansion of our production requirements.

Undoubtedly the confidence in Wickman Automatics stems from the satisfactory service which we have secured and which we now accept as normal.

Yours faithfully,

WORKS DIRECTOR.



. . . *in the long run* . . . .

During its lifetime a high-production machine tool does not normally receive the care and attention conducive to a long life.

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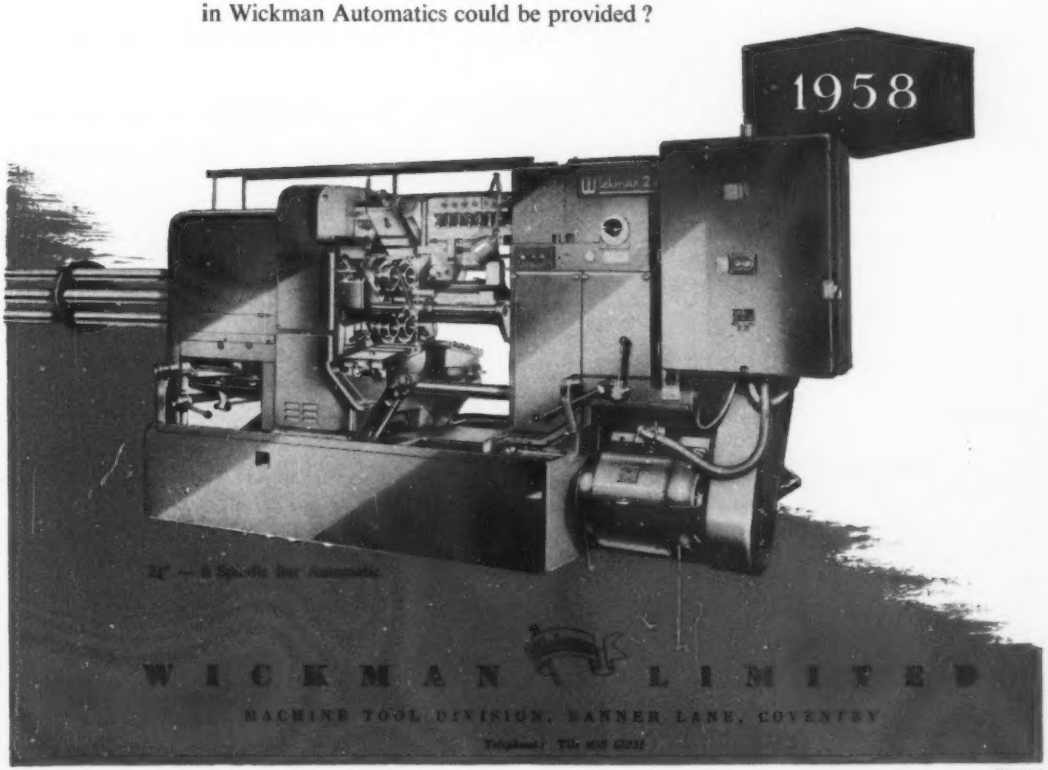
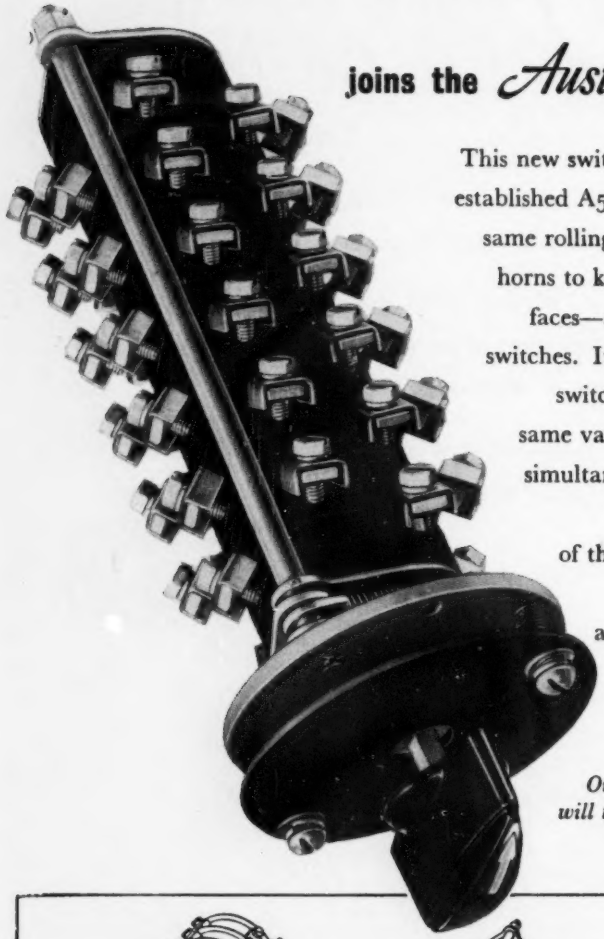


522 WM

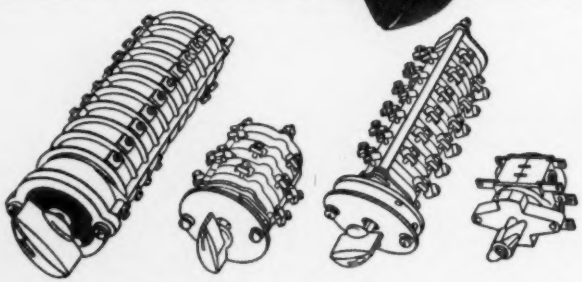
Now the A15—



joins the *Austinlite* rotary switches

This new switch is identical in principle to the well established A50 and A30 rotary switches. It has the same rolling, self-cleaning contacts with extended horns to keep any arcing away from the contact faces—a feature exclusive to Austinlite rotary switches. It has a similarly powerful and positive switch mechanism, and can be built in the same variety of forms to switch in sequence or simultaneously very large numbers of circuits. It is extremely compact, the smallest of the Austinlite multi-cell rotary switches. It bridges the gap between the A30 and the little single-cell 10-amp switch. Delivery, on standard applications, can now be made in four weeks.

Our brochure "SIMPLIFIED SWITCHING" will tell you more about the advantages of Austinlite Rotary Switches. May we send you a copy?



The four Austinlite Rotary Switches—A50, A30, A15 and A10

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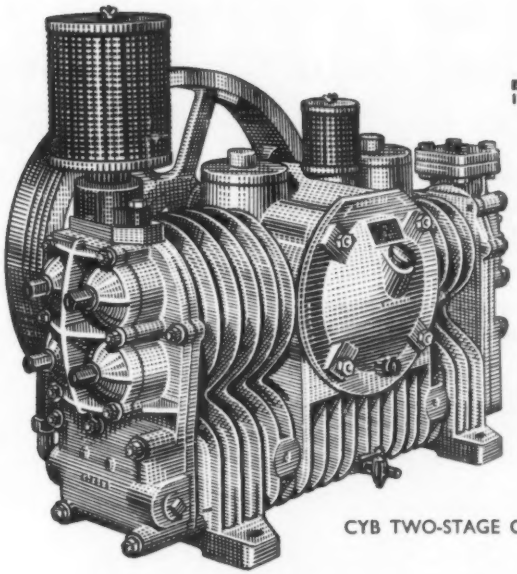

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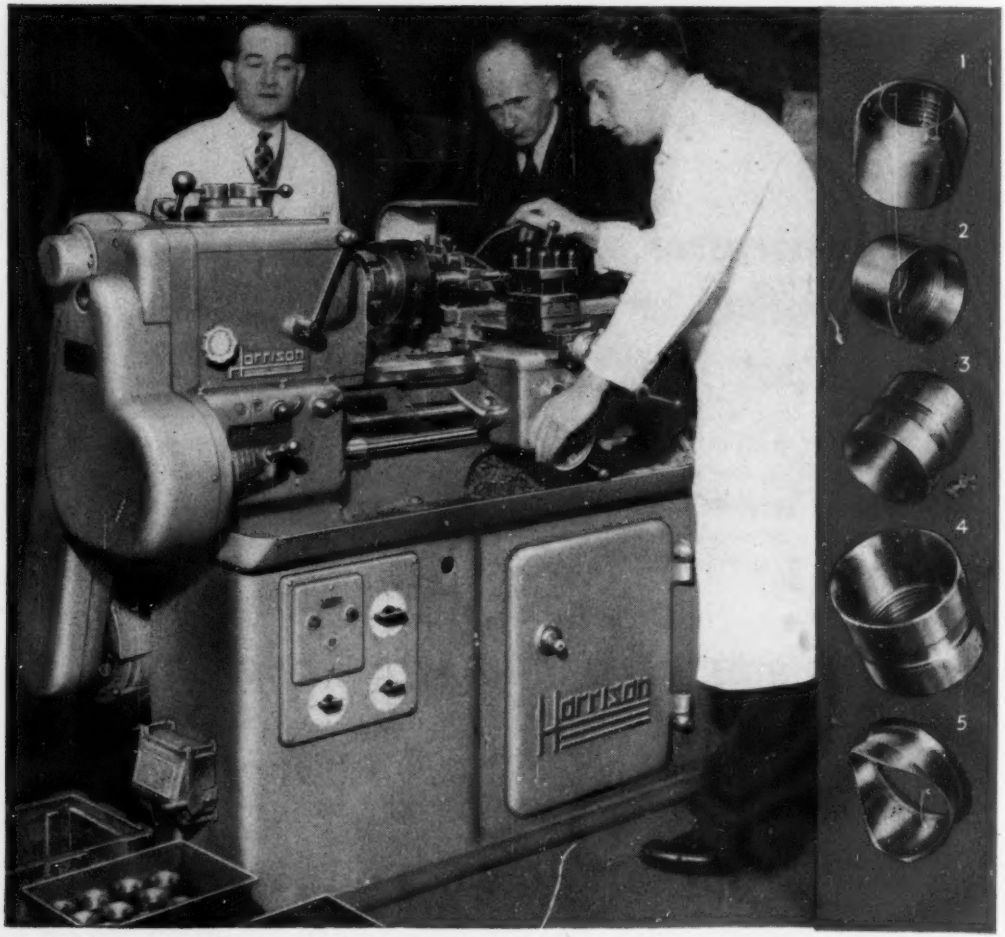

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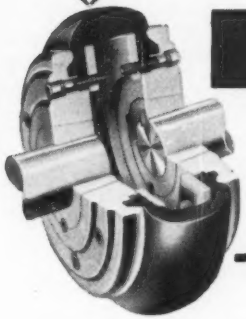
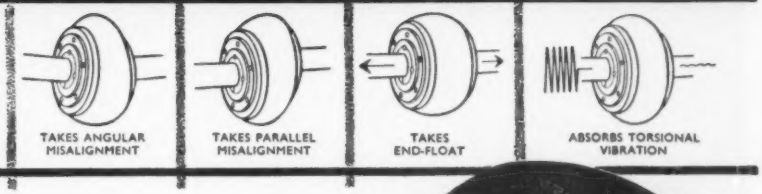


THE RUBBER TYRE COUPLINGS WITH THE 4-WAY FLEX



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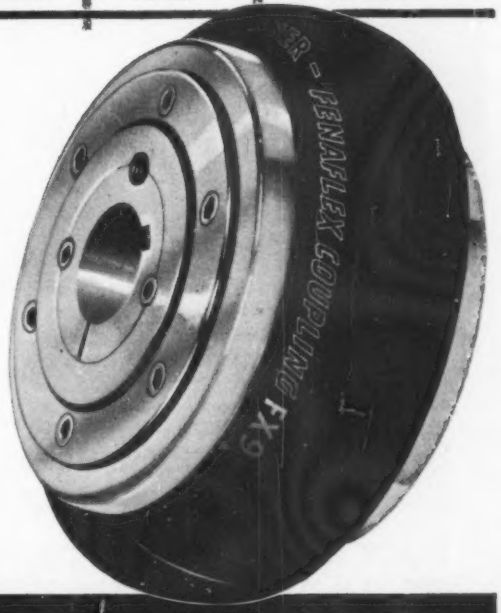

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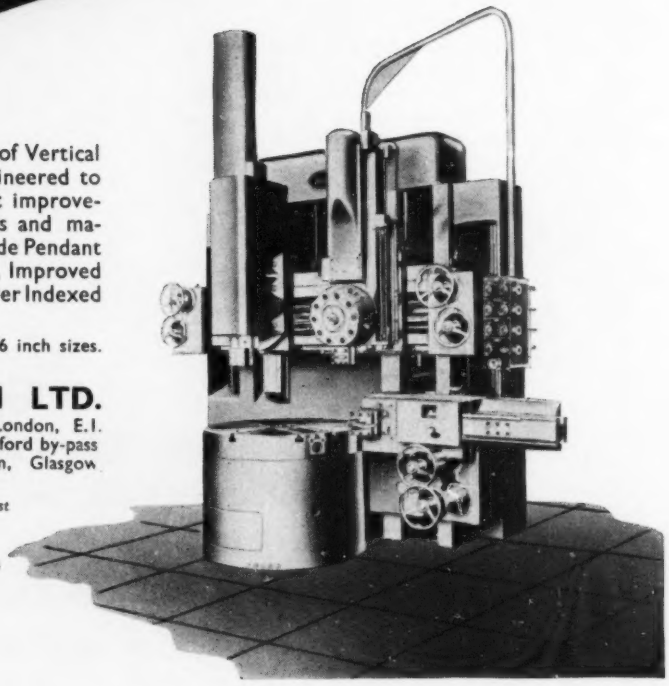

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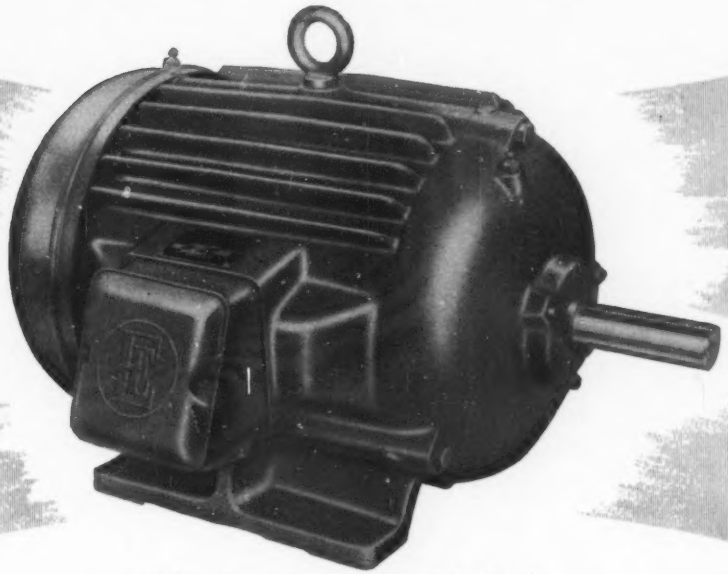

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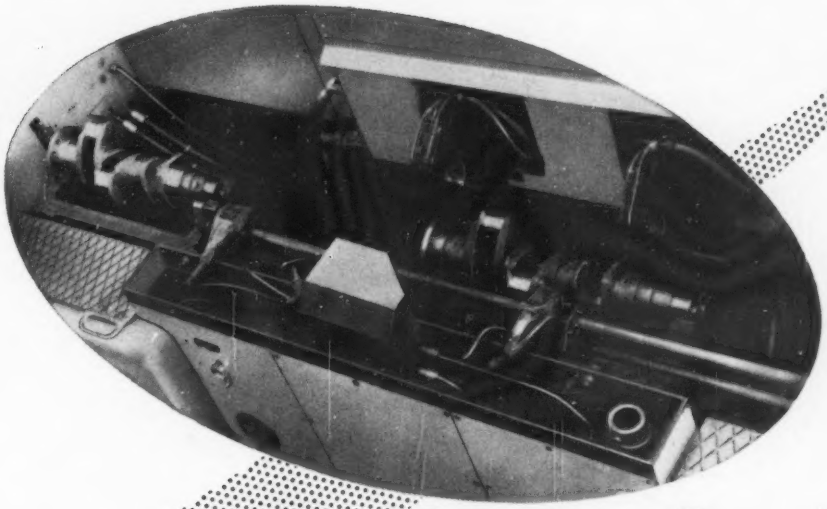

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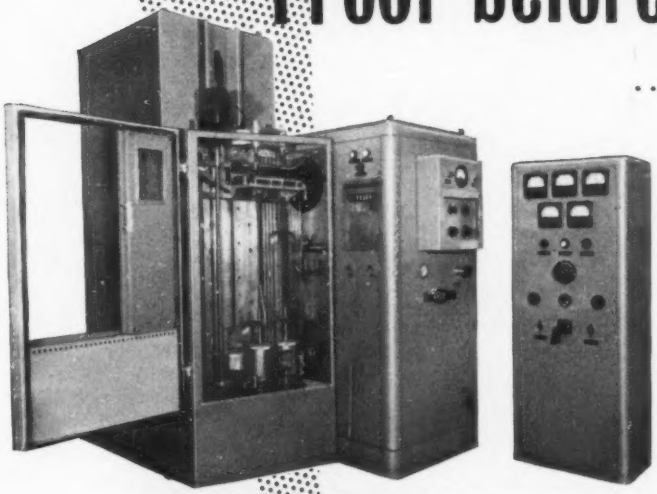

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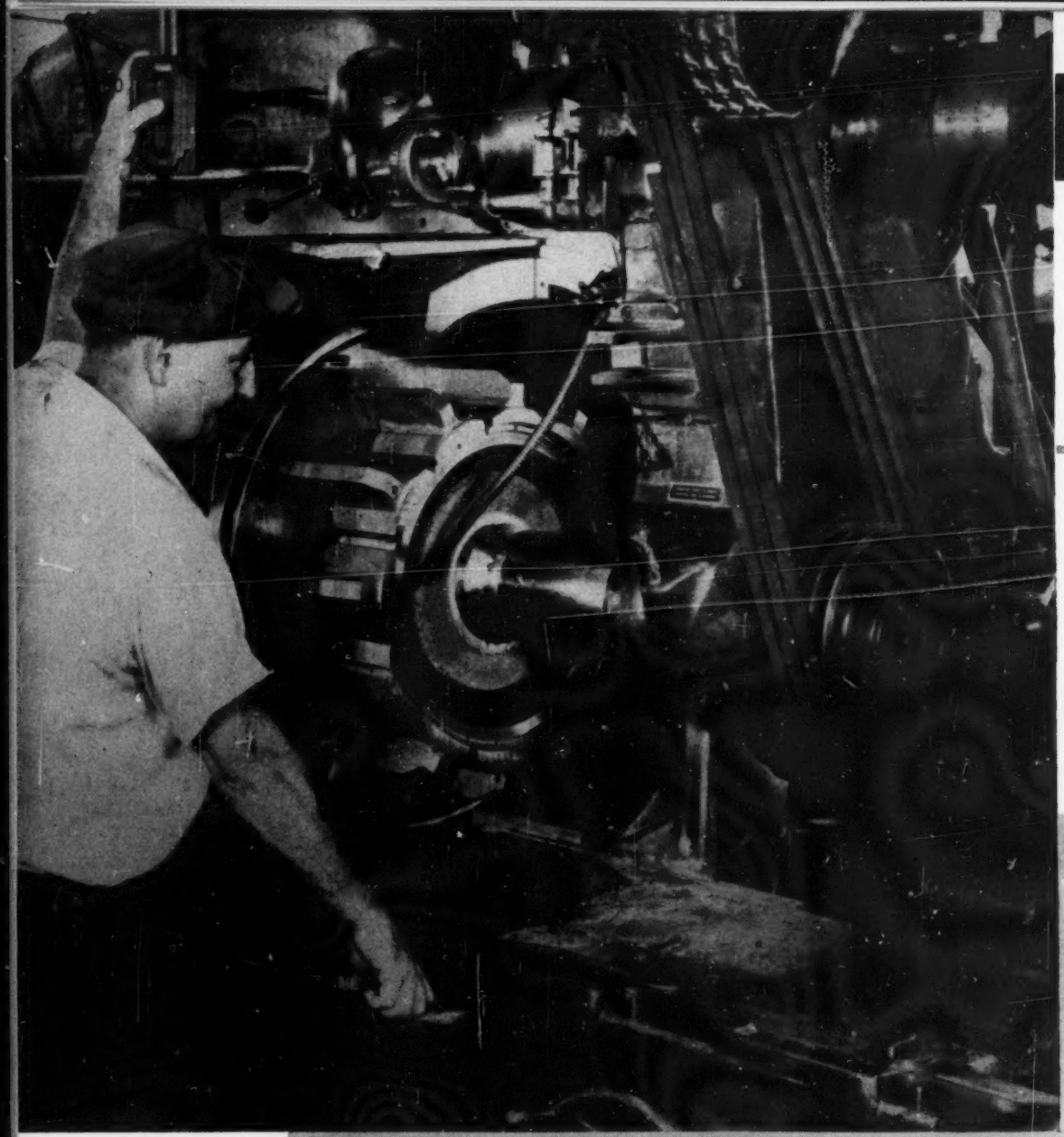

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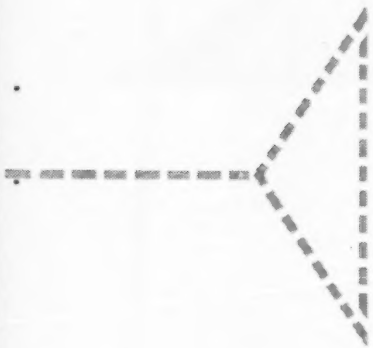

This frail, thin walled, aircraft part is delicately but firmly chucked on two diameters. Because the O.D of the part has a central diameter larger than the diameter of each end, a split bushing is used in chucking the part.

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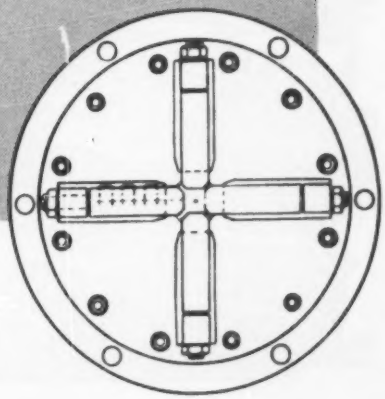

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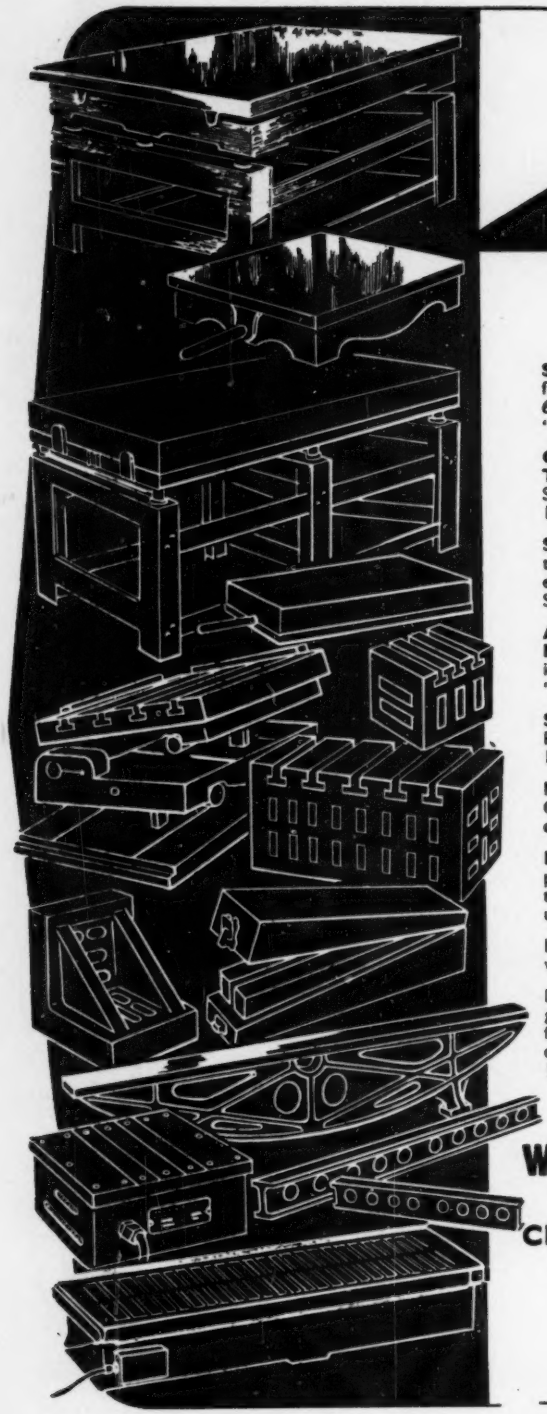

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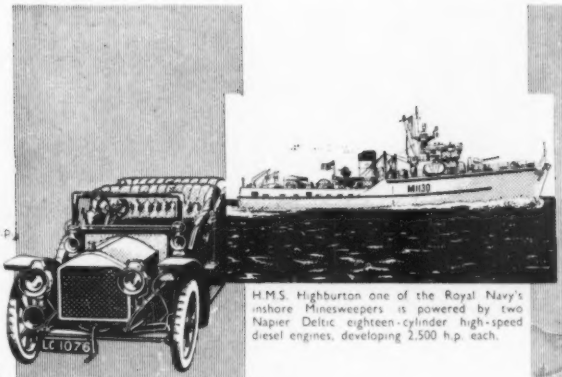

A six-cylinder 30 h.p. Napier car of 1905.

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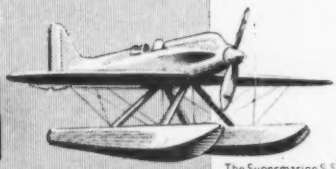

The Supermarine S.5 Napier Lion-powered Schneider Trophy-winner 1927. The engine was a geared Napier Lion VIIB.

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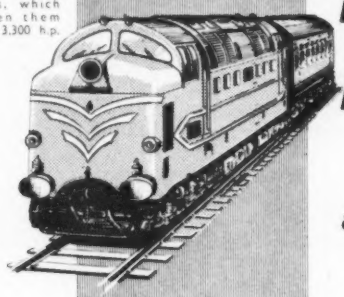

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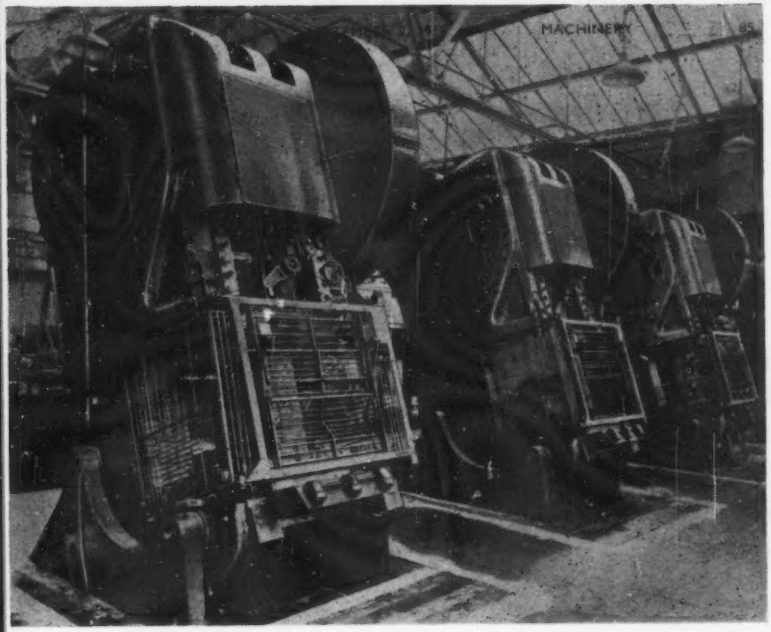

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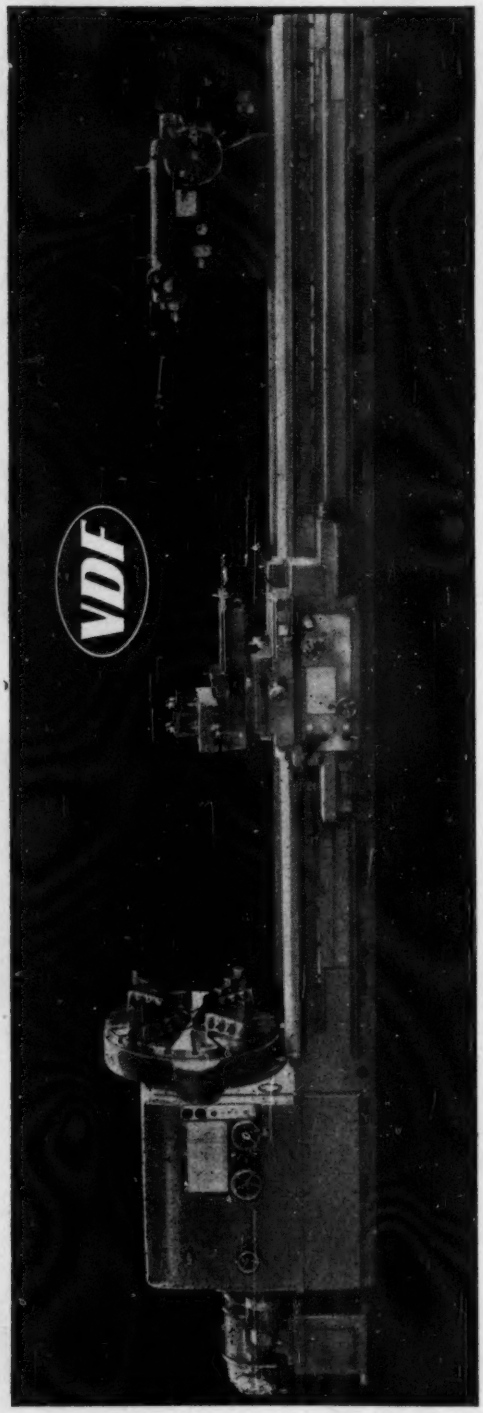

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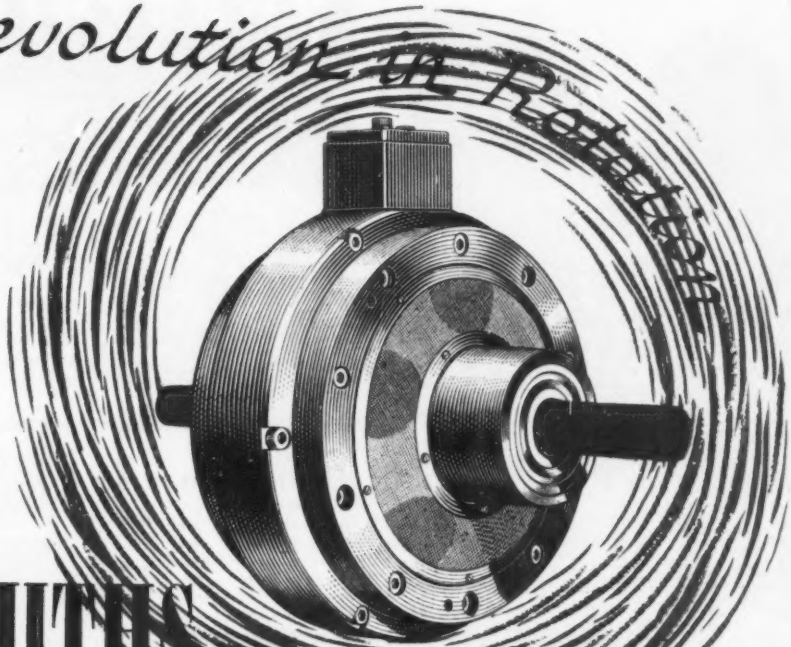

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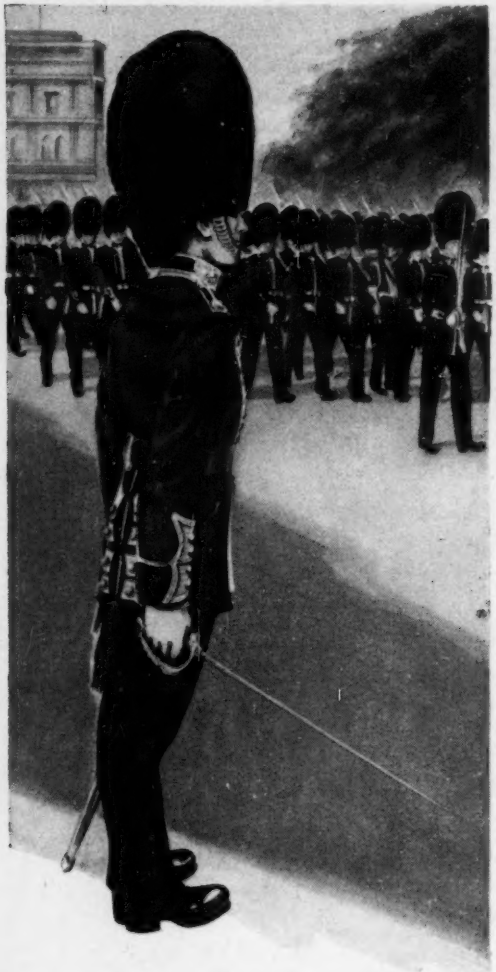

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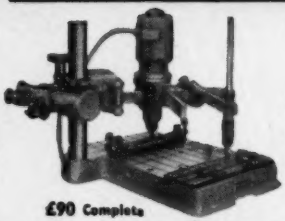

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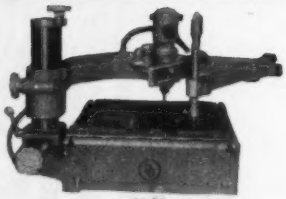

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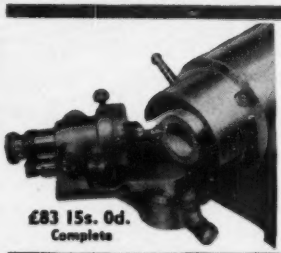

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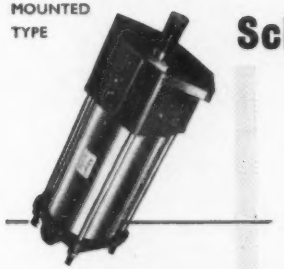

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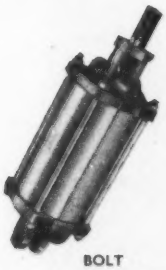

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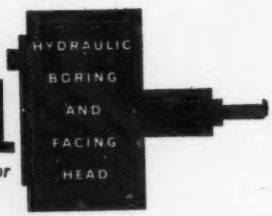

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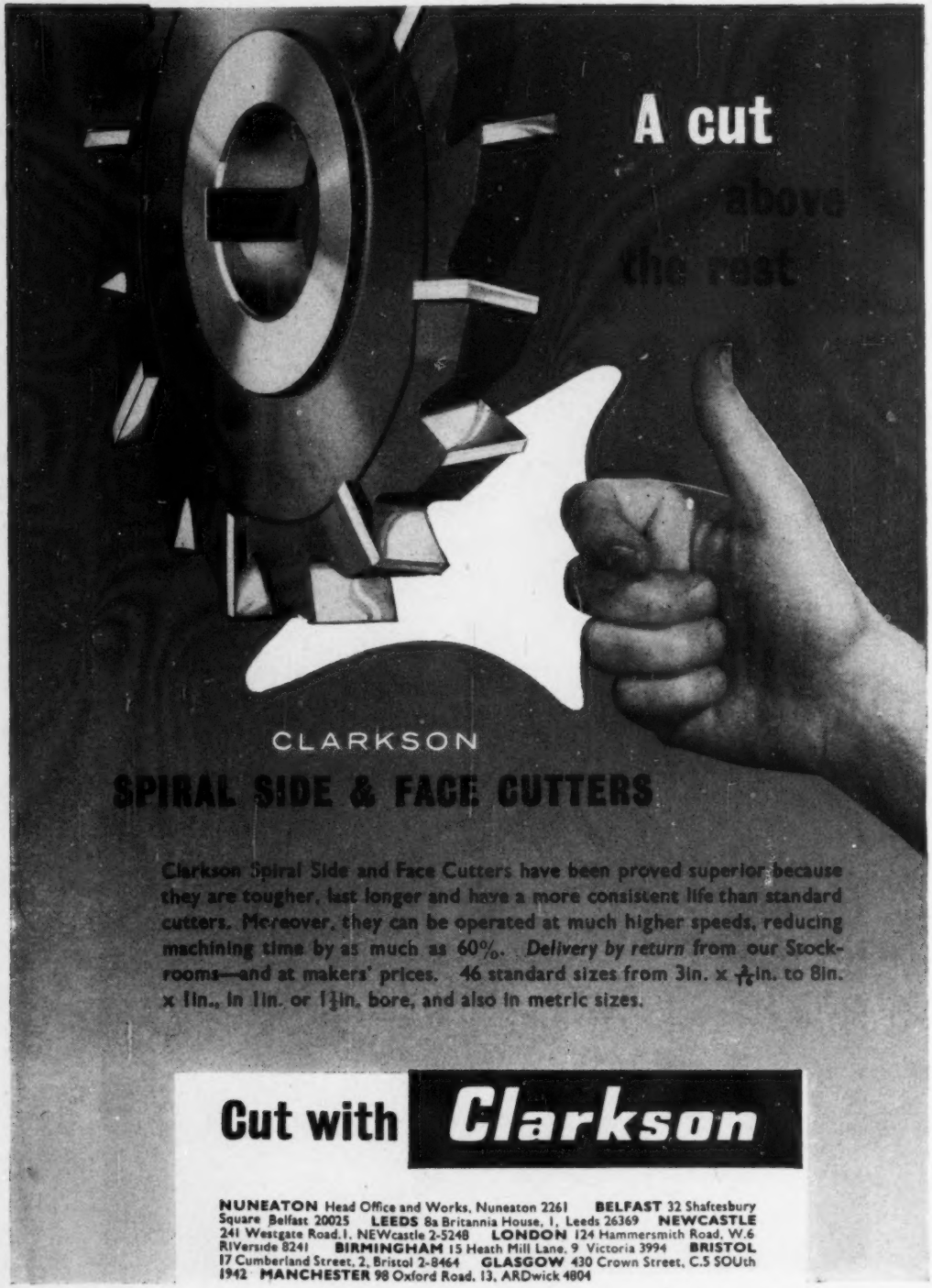

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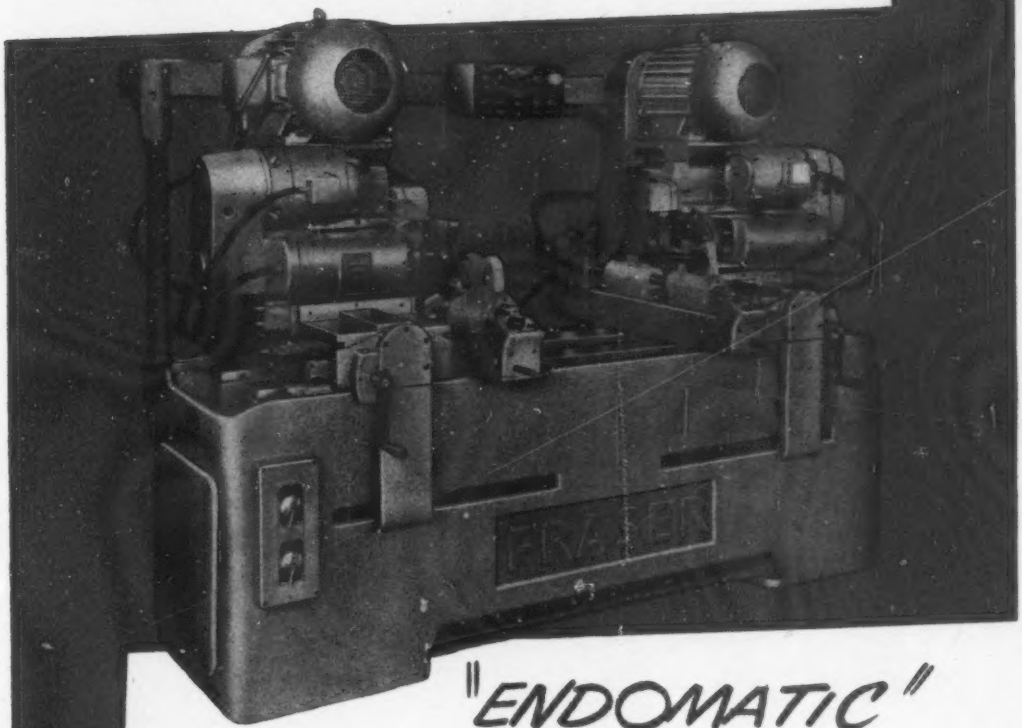

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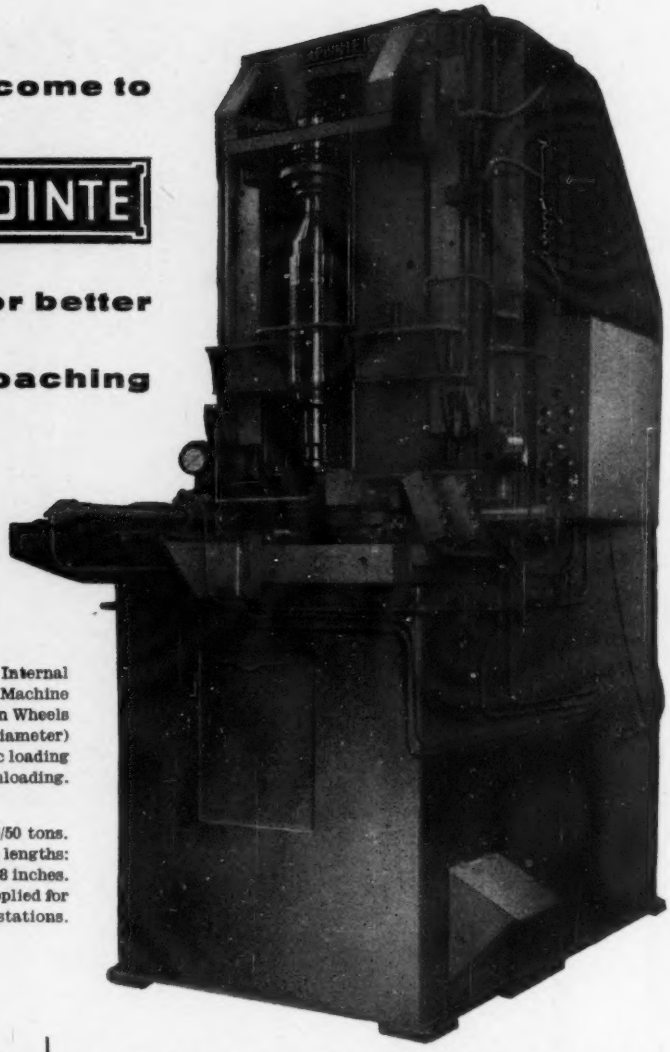

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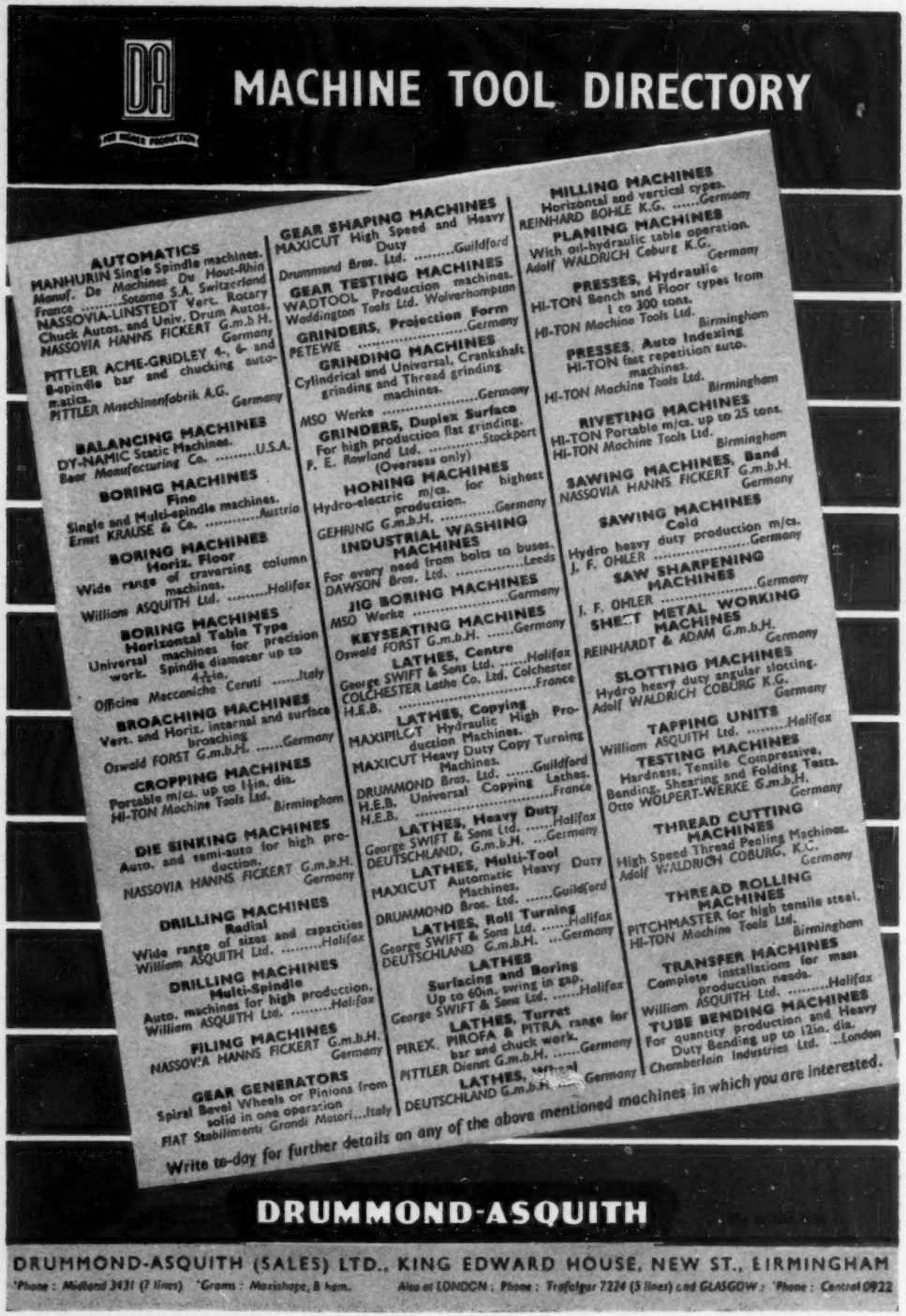
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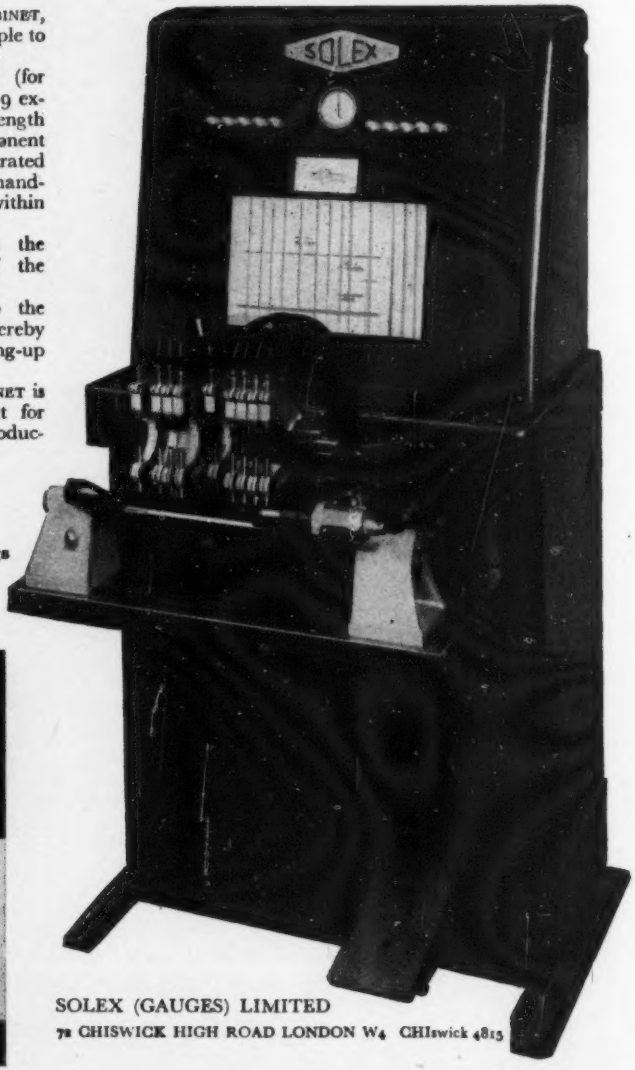

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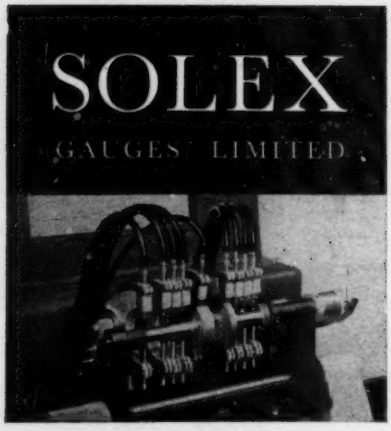

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Abstracts of Principal Articles

Producing the Vauxhall Victor..... P. 512

In this article attention is drawn to some features of the design of the rear axle for the Vauxhall Victor passenger car and methods employed in its production. The axle incorporates a central differential housing with bores for the reception of flanged tubes which enclose the half-shafts. A malleable iron casting, the axle housing is faced at two levels on a vertical ram-type milling machine and is then drilled and tapped for the differential bearing cap bolts. The caps, which are machined on an adjacent line, are next fitted, and most of the remaining operations are performed on a 22-station, in-line, transfer machine. After the axle-tube bores have been machined, the casting reaches a turn-over station, where it is lifted and turned through 90 deg. in both the vertical and horizontal planes before being replaced on the transfer bar. Operations on the driving pinion bore are then carried out, and the cover face is tapped, before the casting is discharged. A special 4-way machine is employed to fine-bore the differential-pinion and axle-tube bores before the casting is washed and inspected, with special air-gauging equipment. Finally, the axle tubes are pressed in, and holes are drilled and plugged to retain them, before the axles pass to the assembly line. (MACHINERY, 93—3/9/58.)

Equipment for the Economical Batch Machining of Large Parts ..... P. 525

The machines here described have been developed to facilitate machining operations on fairly small batches of heavy weld-fabricated parts and castings for road-building equipment. They are characterized by the fact that the various tool heads are mounted on rotary indexing tables, while the work fixtures are carried on saddles which are arranged for shuttle movement on beds disposed radially in relation to the tables. Except for certain operations, such as tapping, the tool spindles have only rotary motions, and the saddle drives provide for rapid traverse and feed. With the simplest arrangement, there is one rotary table and one fixture saddle bed. Machines have also been constructed with two rotary tables and a single fixture saddle bed between them, and with a single rotary table and two radial beds for fixture saddles. Different workpieces are accommodated in the two fixtures and the tooling is designed to enable both to be machined. Other operations are performed on in-line type transfer machines, each of which has one shuttle type fixture, so that the tool heads are in use at only one station at a time. (MACHINERY, 93—3/9/58.)

Grinding Machine Wheel-head and Work-head Assembly ..... P. 530

A. A. Jones & Shipman, Ltd., Narborough Road South, Leicester, have recently completely reorganized and re-equipped the department devoted to the assembly of wheel-heads, work-heads and high-speed spindles, for their range of grinding machines. The area concerned is completely enclosed by steel partitioning, and throughout precautions are taken to ensure the strictest cleanliness. By further partitioning, the area is subdivided into five main sections, which are concerned with general assembly, dismantling, final assembly, running-in, and storage. The dismantling and final assembly sections are in a pressurized area, supplied with filtered, dust-free air. In the fitting section, which is in the general assembly area, the vice on each bench is mounted over a grid, with air-extraction trunking beneath. Typical procedure for wheel-head assembly comprises fitting; cleaning; fitting and building; preliminary running-in; stripping and cleaning; inspection and rebuilding; and final running-in for 10 to 14 days. (MACHINERY, 93—3/9/58.)

Automatic Assembly Machines for Roller Skate Wheels ..... P. 539

One of the machines here described, which is based on a Ferguson Intermittor rotary indexing unit, provides for the assembly of three parts and eight balls, to form a wheel of a simple type. The parts comprise a centre spindle and an inner and an outer shell, the edge of the latter being finally turned in, by means of a hydraulically-operated tool, to complete the assembly. For a more elaborate wheel, comprising 10 parts and two sets of balls, an in-line Trans-O-Mator installation has been provided. This equipment has 14 working stations, at three of which forming operations are carried out. The various components are delivered from hoppers at the rear of the installation, and provision is made for automatically replenishing the contents of these hoppers, as required. Nest fixtures are employed for this assembly, and the sequence of operations at the various stations is described. (MACHINERY, 93—3/9/58.)

Machining Castings for Lada Sewing Machines ..... P. 546

The Lada works at Sobeslav, Czechoslovakia, have an output of 50,000 sewing machines per year, including portable and standard types. Unit-head machine tools are extensively employed for operations on light alloy and iron castings, and some typical set-ups are here illustrated and briefly described. Representative of these machines, which were supplied by the TOS-Kurim works, is a 3-way horizontal type, for drilling, reaming, and spot-facing a base casing. Another machine, for operations on treadle frame casting, has two horizontal unit heads at each end, three vertical heads of special design, and an automatic rising and falling work fixture. Reference is also made to the assembly lines, on which universal swivelling fixturse are employed. Two lines are arranged back-to-back, and the empty fixture from the finishing end of one line are transferred to the adjacent starting end of the other. (MACHINERY, 93—3/9/58.)

Matched Machining

In the early days of quantity production in the metal working industries, the general aim was to achieve complete interchangeability, and thus enable parts to be selected quite at random for incorporation in the final assemblies. Such interchangeability is, of course, highly desirable from the standpoint of economical manufacture, and the principle is still followed with great success where the nature of the mating components permits. Despite the important advances that have been made in machine tool accuracy and performance, however, they have been outstripped in various directions by the demands of the product designer. For example, where a close fit is required between a cylindrical component and a bore, it is necessary to impose exacting limits on the difference between the two diameters. This difference, however, may range from that provided by a high limit hole and a low limit shaft, to a minimum corresponding to a low limit hole and a high limit shaft. To achieve interchangeability, therefore, it would be necessary to impose uneconomically stringent tolerances on both the hole and shaft sizes.

For this reason, the principle of selective assembly has long been adopted, where appropriate, side by side with interchangeable production. Particularly as a result of recent advances in gauging techniques and the development of automatic equipment for this purpose, parts can now be rapidly and economically segregated into various size steps within a broader tolerance band, and in this way the desired refinement of fit can often be obtained without making excessive demands on the machine shop. Even with fully automatic assembly, which is likely to assume increasing importance in the future, the advantages of component selection need not be foregone. On a ball bearing assembly machine, for example, provision can be made for the automatic gauging of an inner and an outer race, and balls of the correct size grade can then be automatically selected to suit the particular bearing.

Whereas very satisfactory results for many purposes can be obtained by selecting parts for assembly in the manner indicated, it may be preferable or convenient in other instances to produce one part to match a particular mating component. This method is, of course, nearly as old as metal working, and it may be noted, for example, that when finishing a recess to receive a bearing jewel, the actual jewel to be fitted may be effectively employed, in conjunction with a stop, to control the bore diameter. During the past few years, however, application of the principle has been considerably extended as a result of advances in work size control arrangements.

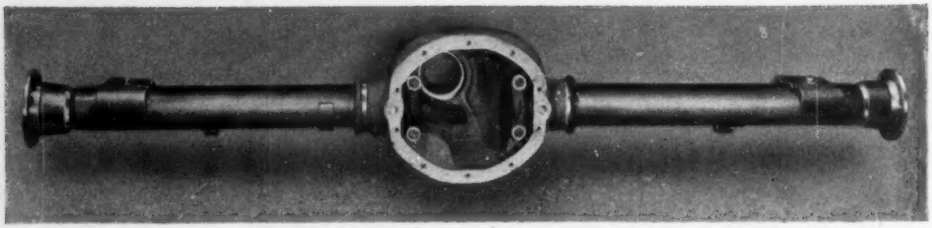
Certain grinding machines are now available whereby such operations are greatly facilitated. One component, with a finished bore, is placed on a gauging mandrel, and the mating part is then finish ground, with automatic size control, to ensure a given clearance, within very close limits, when the two are subsequently assembled. It may be recalled that with such a set-up, described recently in MACHINERY, the plunger component for a hydraulic valve is finish ground in relation to the sleeve to give a tolerance on clearance said to be only 20 micro-inches.

As relative accuracy requirements for various parts become still more exacting, it is probable that the principle of matched machining will be increasingly employed. Hitherto, this technique has been associated mainly with mating cylindrical parts, but other problems are likely to arise which cannot readily be solved either by attempting to achieve interchangeability or by selective assembly.

One example was discussed by Mr. E. M. Hahanson in a paper read before the American Society of Tool Engineers. In order to meet stringent flow test requirements, particularly where high pressures are involved, a precise relationship must be obtained between the lands and ports of the spool and sleeve for a hydraulic servo valve. In addition, of course, the parts must have a good surface finish, the corners of the lands and ports must be sharp, and close limits for roundness, straightness and clearance must be maintained. At one time, it is stated, it was necessary to flow test the assembly, and make corrections by grinding the side faces of the spool lands, as many as eight, ten, or even twelve times, a procedure which was very expensive and made severe demands on the machine operator.

To overcome this difficulty, special equipment has been developed which enables each land face on the spool to be ground with direct reference to the corresponding port edge, to provide the correct positive or negative overlap. For some valves this overlap may be of the order of 0·0002 in. The

(*Continued on page* 564)



Producing the Vauxhall Victor

Operations on Rear Axle Housings

Articles published in MACHINERY, 92/760—4/4/58, 92/944—25/4/58, and 92/1316—6/6/58 were concerned with the new design features of the Vauxhall Victor car and with the high-efficiency methods employed in the main machining building at Luton for the production of gearbox components and stub axles. A fourth article, which appeared in MACHINERY 92/1432—20/6/58, gave details of the new press shop recently completed as part of the company's £36 million expansion scheme. The present article is concerned with the advanced methods, including the use of rotary and in-line automatic transfer machines and other modern equipment, for operations on rear axle housings for the Victor 4-cylinder car, which is in current production. The rear axle employed for this car, shown in the partly-assembled condition in the heading illustration, is of composite construction, incorporating a central differential housing of malleable cast iron, with bosses at the sides into which are inserted tubes for encasing the axle drive shafts.

Each drive shaft (or half-shaft), the production of which will be described in another article, has a flanged end with drilled holes for the insertion of the wheel mounting studs, no separate hubs being required. Brake drums too, are unusual, in that they have central disc-shaped webs of pressed sheet steel, round which the iron drums are cast, substantial reductions in both weight and cost being thus obtained. A point of interest in connection with the axle is that it is mounted in a position which is slightly forward of the centre of the half-elliptic rear springs. This mounting position, in conjunction with an anti-roll bar at the front of the car, is designed to provide inherently stable "under-steering" characteristics by increasing the natural weight transfer between the inner and outer front wheels during cornering. The arrangement also ensures that the car will hold its course on the straight against the influence of side winds or road irregularities, and is light to control.

Details and main dimensions of the rear axle housing are given in Fig. 1, and it will be seen that it is of conventional design and incorporates a main bore at *A*, in which the hypoid bevel pinion is supported on pre-loaded taper-roller bearings. At right-angles to this bore are the two circular bosses in which the axle tubes, mentioned above, are retained by pins, and in line with these bosses there are two split bores to hold the end bearings of the differential casing. These split bores are formed half in the casting and half in two bearing caps, which are retained by means of bolts, as shown in the heading illustration, and in the sectional view, Fig. 1. The castings are supplied to the first machine in the line in the shot-blasted condition, and the preliminary series of operations includes those required preparatory to fitting the differential bearing caps, which are machined nearby. With these caps in place, the castings are loaded into an in-line transfer machine for turning, boring and other operations and, finally, into fine-boring machine, on which all the bores are finished at one setting.

SPECIAL CINCINNATI MILLING MACHINE

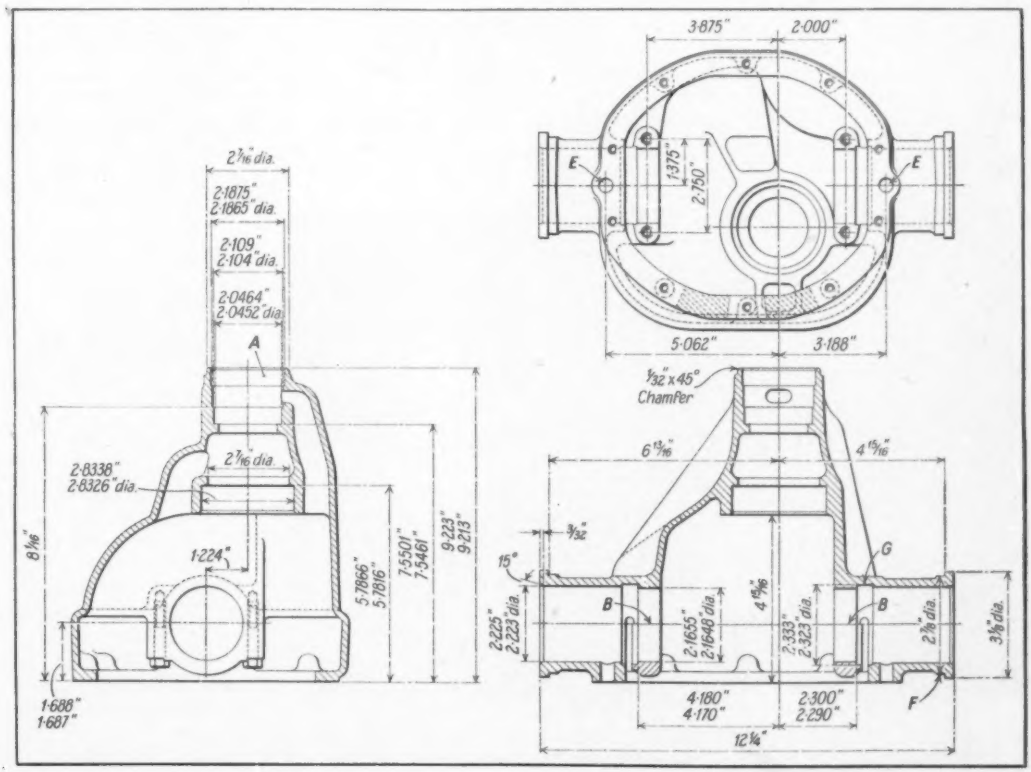
The first operation on the rear axle housing consists of machining the cover face, to which a pressed sheet metal cover is eventually fitted, and the internal faces *B*, Fig. 1, for the bearing caps. This work is carried out on the special Cincinnati vertical ram-type milling machine shown in Fig. 2, which is installed at the head of the line. A circular table on this machine supports the work-holding fixture near its centre and is fitted with

sheet metal covers to keep the fixture clear of swarf and coolant. In the fixture, the casting is supported by the axle tube bosses, and the extension at the lower end is clamped hydraulically by means of a floating V-block. Curved levers, pivoted in slots at each side of the fixture, are moved outwards at their lower ends, by the rams of hydraulic cylinders within the fixture, when the clamping button is pressed.

Consequently, the upper ends of the levers swing inwards and down to enter and apply pressure to the cored tube bosses. Before the work is clamped, the gauge *C*, Fig. 2, is swung over on its hinge pin into the aperture, to check that the casting has been positioned correctly in the fixture and to ensure that approximately equal amounts of material will be removed from each side. The gauge must then be returned to the position shown before the automatic machine cycle can be initiated by means of a push-button. The vertical spindle of the machine, which is carried at the end of a horizontally-moving ram, is fitted with two Galtona (Richard Lloyd, Ltd.) milling cutters, one above the other. The larger of these cutters, at the top, is of 6¾ in. diameter and has 20 inserted blades tipped with tungsten carbide.

The lower cutter is of angular shape, to clear projections on the casting. It has a diameter of 4⅜ in., and is equipped with 12 carbide-tipped blades. The spindle is driven at a speed of 180 r.p.m., and the table completes one revolution in 55 sec., moving in an anti-clockwise direction, as viewed from above. When the cycle start button is pressed, the table and the cutter spindle start to rotate and the spindle ram is moved forward until it is directly above the casting. The spindle is then lowered to a fixed height so that the cutters engage the work, and the table is driven through one revolution. The position of the cast-

Fig. 1. The Rear Axle of the Vauxhall Victor Car Incorporates a Central Housing of Malleable Iron, Details and Dimensions of which are Here Given, with Bores to Accommodate the Driving Pinion, Differential Bearings and Axle Tubes



ing relative to the table centre provides for feed rates of 34·8 and 26 in. per min. for the large and small cutters respectively. At the end of the table revolution, the spindle is raised and retracted on its ram to the position shown, and the table is stopped in readiness for unloading. Cooledge (Fletcher Miller, Ltd.) soluble oil is employed on this and other machines in the line.

ASQUITH 6-STATION MULTI-SPINDLE MACHINE

From the milling machine, the castings pass on a length of inclined roller conveyor track to the adjacent Asquith [Drummond-Asquith (Sales), Ltd.] 6-station rotary transfer machine shown in Fig. 3, on which drilling, reaming, chamfering and tapping operations are performed. The indexing table carries six fixtures of similar design, spaced at 60 deg., and each fixture incorporates two inclined support bars *D*, on which the casting rests initially, on the axle-tube bosses. After the casting has been pushed along on these bars into the fixture, as shown in Fig. 3, it is located by means of a gauge, which is inserted through shaped apertures in the flat top face of the fixture. In this position, the tube bosses are directly above horizontal beams within the fixture, each beam having V-faces to engage with the outside surface of the boss above.

The beams are supported on pairs of vertical plungers which can be raised or lowered mechanically by a motor-driven unit in front of the machine at the loading position. Drive is transmitted from this unit by means of a hexagon socket, which is engaged by the operator with a shaft of similar shape, projecting from the front face of the fixture, when loading is to be carried out. Buttons on a pendant panel provide for starting the drive in the required direction, and when the vertical plungers are raised the casting is lifted off the support bars and clamped with its cover face in contact with the underside of the fixture top plate. The machine cycle-start button is then depressed and the table is indexed in a clock-wise direction to carry the newly-loaded fixture to the first machining station, on the left in Fig. 3.

The machine is equipped with two multi-spindle heads, both of which can be seen in Fig. 3, and the head at the left, which is of the screw-driven type, is employed for drilling, chamfering, and reaming six holes in the top of the casting. Of these holes, two, indicated at *E* in Fig. 1, are employed for dowel-location purposes during later machining operations. The other four holes are subsequently tapped for the reception of the holding-down bolts for the bearing caps, and all these holes are completed by the 14 spindles in the head at the first three machining stations. Drive to the head is taken from a 7½-h.p. motor, and the drills, which range in size from 0·272 to $\frac{11}{16}$ in. diameter, are driven at speeds of 334 to 773 r.p.m., the head being fed down at 2·36 in. per min. for the working stroke.

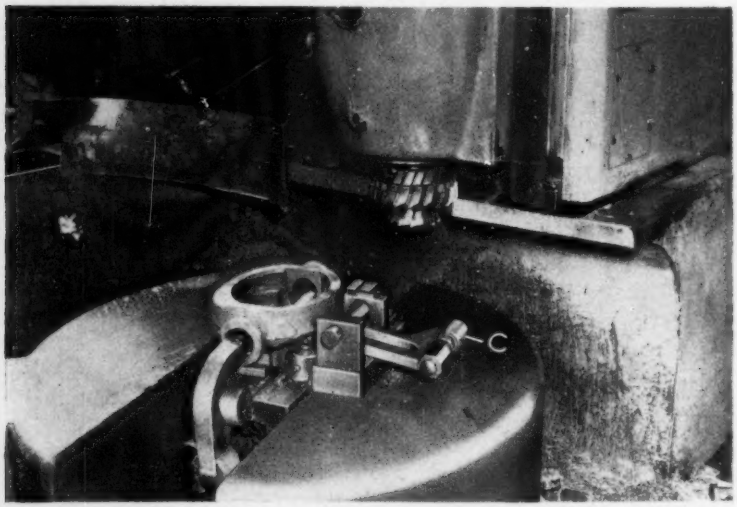


Fig. 2. Employed for the First Operation on the Axle Housing, this Cincinnati Vertical-spindle, Ram-type, Milling Machine has Two Cutters, which Machine the Bearing Cap Joint Faces and the Cover Face

Station four is equipped with a blow-out head, which is employed to clear the drilling swarf and to probe the holes to ensure that they have been drilled to the correct depth, ready for tapping. The latter operation is performed, by the head at the right in Fig. 3, on the four holding-down bolt holes, which are tapped $\frac{5}{16}$ in. by 24 U.N.F.-2B. A spindle-speed of 208 r.p.m. is employed for tapping and the head is fed down at the correct rate to suit the thread pitch by means of a cam. The casting then arrives at the loading station

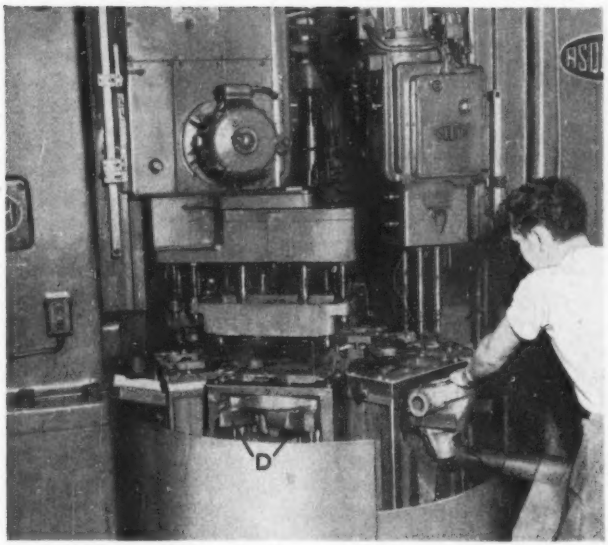


Fig. 3. On this Asquith Rotary Machine, the Bearing Cap Bolt Holes are Drilled and Tapped and Two Dowel-locating Holes are Drilled and Reamed

where it is removed by a series of operations similar to that described, and placed on a roller track to continue its journey along the line, to the point at which the bearings caps are fitted.

OPERATIONS ON BEARING CAPS

As may be seen from Fig. 1, the bearing caps employed in the axle housing are of conventional shape, and they are machined from malleable iron castings on machines adjacent to those so far described for operations on the axle housing. Only two operations are required to prepare these castings for fitting into the axle housings, and the first is performed on a Cincinnati duplex Hydromatic horizontal milling machine. A single fixture on this machine accommodates six castings—three on each side—and they are loaded on their sides with the joint faces outwards. Facing cutters, on each side of the fixture, are then applied, to machine the joint surfaces with an automatic cycle. From this machine, the caps are transferred to a Pollard No. 28A production drilling machine, shown in Fig. 4, on which the two bolt holes are drilled, chamfered, and spot-faced, four caps being loaded at a time.

The indexing table of the machine is fitted with four fixtures, each of which has provision for clamping two fresh and two partly-machined castings. Fresh castings, which have been machined only on the joint faces, are loaded at the left-hand side of the fixture and rest on these faces between fixed and movable clamping elements. Each moving clamp is advanced mechanically by means of a horizontal shaft, with a slotted outer end which projects at the front of the fixture. These shafts are turned with the aid of the large hand-wheel which is mounted on a short horizontal shaft in a swinging bracket, so that it can be moved from side to side. The end of the hand-wheel shaft adjacent to the fixture has a tenon, and each of the fixture shafts a matching slot.

The first circuit of the castings on the machine provides for drilling ⅜ in. diameter, and spot-facing the bolt bosses, and when the castings again reach the loading station they are unclamped and transferred to the right-hand side of the fixture. Here, the castings are loaded in the inverted

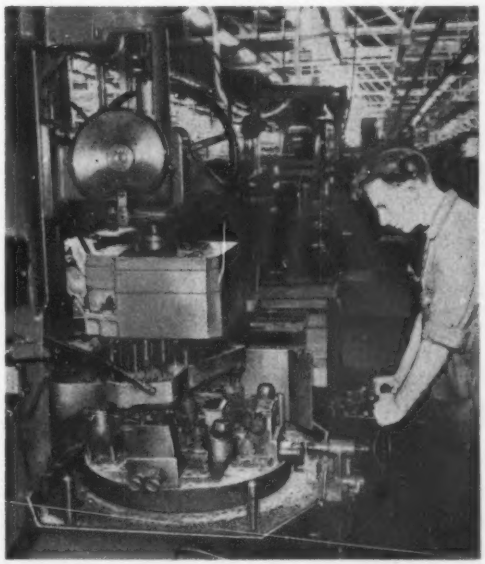


Fig. 4. Bearing Caps, Milled on the Joint Face, are Drilled, Spot-faced and Chamfered on this Pollard Multi-spindle Four-station Indexing Machine on which Clamping is Effected by Means of the Hand-wheel at the Front

Fig. 5. General View of the Cross Transfermatic 22-station Transfer Machine on which the Majority of the Operations on the Axle Housing are Performed, After the Differential Bearing Cap Caps have Been Fitted

position, so that they rest on the spot-faced bosses, and the joint-face ends of the bolt holes are chamfered as they pass through the machine a second time. The drill spindle is fitted with an adapter carrying 16 spindles, and at the first machining station, at the side nearest to the camera in Fig. 4, the four bolt holes are drilled. Eight spindles at the rear of the machine then ream these holes and chamfer those of the second-cycle castings, and four more spindles on the further side of the machine perform the spot-facing operation. The table is indexed by means of the ball-handled lever in the foreground, and the cam-actuated automatic machine cycle is then initiated by means of another lever on the spindle housing.

CROSS TRANSFERMATIC 22-STATION TRANSFER MACHINE

After the bearing caps have been fitted to the axle housing the four bolts are tightened simultaneously, to a pre-set torque, with a special Thor air-operated wrench. The axle housings are then delivered to the loading end of a Cross Transfermatic 22-station, in-line transfer machine, a general view of which is given in Fig. 5. Apart from the subsequent fine-boring of the axle-tube and pinion-bearing bores, this machine provides for all the remaining operations on the housing and has an output of 60 castings per hour at 80 per cent efficiency. Normally, about 500 castings are completed per 8-hour shift. No pallets are employed on the machine, and for the initial series of operations, on the axle-tube bores, the castings travel cover face downwards. Transfer of each casting from station to station is effected by means of a hydraulically-operated walking-beam mechanism which lifts all the castings, moves them sideways for the required distance, and lowers them.

Initially, each casting is loaded, cover face downwards, on support faces at the sides of the transfer track, and is located by fixed dowels which project from these faces and are engaged by the operator with the locating holes *E*, Fig. 1, as the casting is placed in position. At each of the first four machining stations, at which operations are performed on the axle tube bosses, the casting is clamped hydraulically, from above, by means of a vertical plunger whereby pressure is applied to the driving pinion boss. These four stations are arranged in pairs, and each pair is served by a single two-spindle head on each side of the machine. The first station—No. 3 on the machine—provides for rough-boring the two differential bearings and the axle-tube bosses, about 0·030 in. being left in the smaller holes, and chamfering the outer end of each bore.

For this purpose, the spindles are equipped with cutters having four inserted carbide-tipped blades, which take cuts up to ⅛ in., and single-point tools for the chamfering operations. A spindle speed of 322 r.p.m., and a feed rate of 9·3 in. per min., are employed. At the next station, the same bores are semi-finished with combination tools provided with four inserted carbide-tipped blades, leaving about 0·016 in. for the finishing operation, at approximately the same speed and feed. Two idle stations follow, and the next machining stations provide, successively, for facing the rear of the flange, down to the diameter *F*, Fig. 1, at the outer end of each boss, and cutting an internal recess *G*, Fig. 1, adjacent to each differential bearing bore.

The diameter *F*, it may be noted, in conjunction with the adjacent machined face, serves to position the casting accurately during the transfer movements at later stages of the machining sequence.

Similar tooling is employed for all four bores at stations 7 and 8, and some details may be observed in the close-up view of station 8, given in Fig. 6. This illustration shows the head in the retracted position but with the tool-holder still engaged with the fixture support casting. Each tool-holder incorporates a slide which can be fed inwards for the facing and outwards for the recessing operation, and retracted, power for moving the tool being supplied by means of hydraulic cylinders, one of which is seen at *H*. A cylinder is carried on the outer end of each spindle and is supplied with oil through a rotary connection. As the ram of the cylinder is advanced or retracted, it turns a horizontal shaft within the head casting. On the the outside of the casting, the shaft is fitted with two levers *J*, and, as the shaft is turned, these levers operate limit switches on the side of the head to control the movements of the tool and the head.

With the spindles rotating at speeds of 220 and 295 r.p.m., for the facing and recessing operations respectively, the unit heads are advanced at a fast-traverse rate with the tools retracted. On reaching the pre-set positions, the heads are stopped, and the cylinders *H* are then employed to feed the tools at 1·76 in. per min. in the required directions. When all the tools have reached the full depth, which takes longer for the facing tools since they have a greater distance to travel, they are retracted, and the heads can then be withdrawn. On leaving station 8, the casting is held at an idle position for one machine cycle and is then moved to the turn-over station, just visible at the extreme right in Fig. 6, where it is turned to a position suitable for the succeeding operations on the pinion bore.

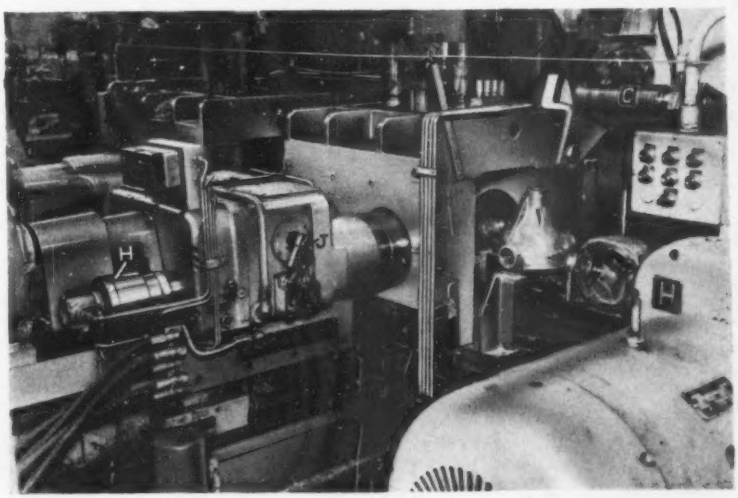


Fig. 6. The First Four Machining Stations on the Cross Machine Provide for Operations on the Axle-tube Bores, and the Head Shown is Equipped with Hydraulic Cylinders, as at *H*, to Apply Lateral Feed to the Facing and Recessing Tools

AUTOMATIC TURN-OVER STATION

Another view showing the turn-over station, No. 10 in the sequence, from the right-hand side of the machine as viewed in the direction of transfer, is given in Fig. 7. The automatic unit employed for turning over the castings is hydraulically operated, and is designed to impart movement through 90 deg. in both the horizontal and vertical planes simultaneously, and to replace the casting on the machine so that it occupies the position shown for the remainder of the machining operations. The portion of the transfer bar serving these later stations is equipped with a series of brackets having V-grooves in their upper surfaces, in which the castings rest on the diameters *F*, Fig. 1, and are positioned laterally by the faces of the adjacent flanges. In addition, projections on the further side of the bar support the overhanging portion of each casting, containing the pinion bore.

Two large-diameter cylindrical posts on the far side of the machine, Fig. 7, support a vertically-moving cross-head which is raised and lowered by means of a central hydraulic cylinder. On this cross-head, there is a housing for a shaft which is held at an angle of 45 deg. both to the horizontal and to the centre-line of the transfer track. The shaft can be turned through slightly more than 90 deg. by means of another hydraulic cylinder *K*, operating through a rack and pinion arrangement, and it carries a pick-up unit *L*, at the lower end. This pick-up unit is equipped with two jaws, which can be moved towards and away from each other by means of another hydraulic cylinder at the rear of the cross-head. The latter cylinder is mounted

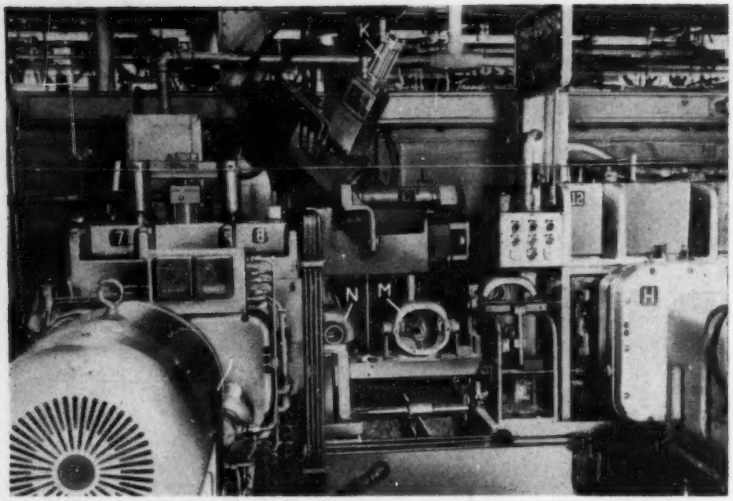


Fig. 7. In this View of the Turn-over Station on the Cross Machine, the Casting Next to be Re-positioned is Seen at *N*, and the Casting which has Just Been Turned, at *M*

in line with the axis of the shaft carrying the pick-up unit, and its ram extends through the hollow shaft to operate the jaws by means of another rack and pinion arrangement.

Each of the jaws of the pick-up unit has a stub spigot, of such a diameter that it can enter the semi-finished axle-tube bore, on its inner face. In addition, the right-hand jaw has two finger projections which embrace the casting to prevent it from rotating on the spigots when it is picked up. The sequence of operations for turning over the casting starts with the movement of the two transfer bars, for the first and second sections of the machine, upwards and to the right. When this movement takes place, the casting which is seen at *M* in Fig. 7 immediately after the completion of the turn-over operation, is transferred to an idle station, No. 11. At the same time, a casting *N*, at idle station No. 9, is transferred to the position occupied by that seen at *M*, ready to be turned over.

The clamping unit *L*, is next turned by the cylinder *K* until the axes of the stub spigots are parallel with those of the axle-tube bores on the casting which is to be turned over. Lowering of the transfer bars then takes place so that the castings at other machine stations can be engaged with their dowels and clamped, and the machining cycle can begin. The cross-head is now lowered by means of its cylinder until the axes of the stub spigots are aligned with those of the axle-tube bores on the casting to be turned over, and the hydraulic cylinder at the rear of the unit is operated to close the jaws so that the spigots engage the bores. The cross-head is subsequently raised, to lift the casting from the transfer bar, before the cylinder *K* is operated to turn the shaft carrying the pick-up unit through 90 deg. to the position shown.

Both transfer bars are now returned to the left, ready for the next cycle, so that the bar for the left-hand section of the machine is retracted from the turn-over station, and the other bar is beneath the raised casting. The cross-head is now lowered to place the casting on the transfer bar in the position shown, and the jaws are opened before the cross-head is again raised, ready for the next transfer cycle. A view from the further side of the machine showing the turn-over station (No. 10) at the extreme right, is given in Fig. 8, where a casting, gripped between the jaws of the turn-over unit, is seen being raised from the first-section transfer bar. From the idle station No. 11, at the left of the turn-over position, the casting is transferred to the first of two combined stations at the centre in this illustration. The locating and clamping arrangements are similar for all the remaining stations of the machine, and the clamping mechanism can be clearly seen in Fig. 8.

In the cradles of the transfer bar, each casting is held with its cover face in a vertical position, just clear of the vertical inner face of the fixture to which it is to be clamped. Horizontally-moving dowels are advanced, by a mechanism to be described later, to engage the locating holes *E*, Fig. 1, before clamping pads are moved into position at the rear of the casting. These clamping pads are carried on levers attached to a substantial bar *P*, which extends through all the remaining fixtures of the machine. The bar is turned through about 90 deg., to advance and retract the clamping pads, by means of a vertical hydraulic cylinder *R*, to the ram of which it is connected by a link. There are two clamping pads for each casting and each pad has V-surfaces, which are moved into positions opposite the axle-tube bosses.

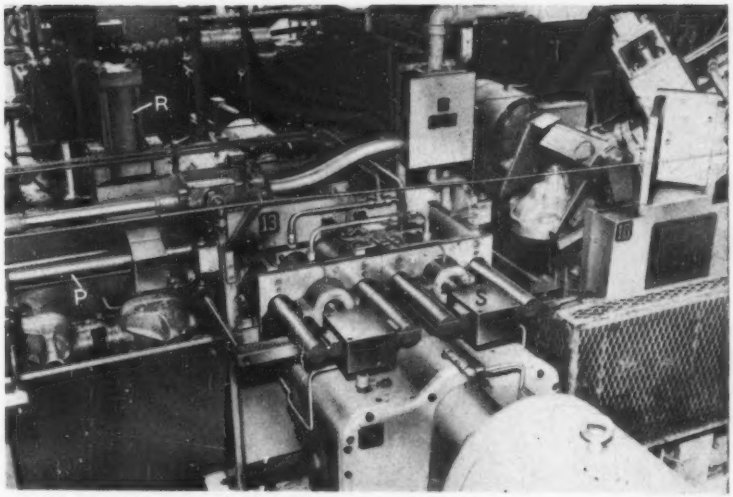


Fig. 8. In the Fixtures Following the Turn-over Station, here seen at the Right, Clamping is Effected by Hydraulically-operated Horizontal Plungers After Pads have been Lowered into Position by the Cylinder at *R*

Clamping is then effected by applying pressure to these pads by means of a separate hydraulic cylinder for each casting. These cylinders are arranged horizontally in the fixtures, above each clamping position, and the ram of each cylinder is connected, by means of a cross-bar, as at *S*, to two horizontal plungers whereby the load is applied to the clamping pads at each station. Details of the mechanism whereby the locating dowels are advanced and retracted at each station may be seen in Fig. 9, which shows stations 12 to 16, and is taken from the right-hand side of the machine, as viewed from the loading end. In addition to those at the machining positions, dowels are also advanced at the idle stations, two of which (No. 14 and 15) are here shown. The two dowels for each casting are secured to a common cross bar *T*, on the outside of the fixture wall, and this bar has a slotted bracket with a swivel pin for a vertical lever.

This lever is pivoted at an intermediate point, and at the lower end it is connected to a steel block *U*, attached to a bar *W*, which extends through all the remaining machine fixtures. The bar *W* carries slotted brackets whereby it is connected to the ram of a small, vertical, hydraulic cylinder *X*, mounted on the side of the fixture at station 13. When this cylinder is operated, the bar *W* is turned and the locating dowels are advanced or retracted. The spindle head on the right-hand side of the machine serving stations 12 and 13, which are seen at the left in Fig. 9, is

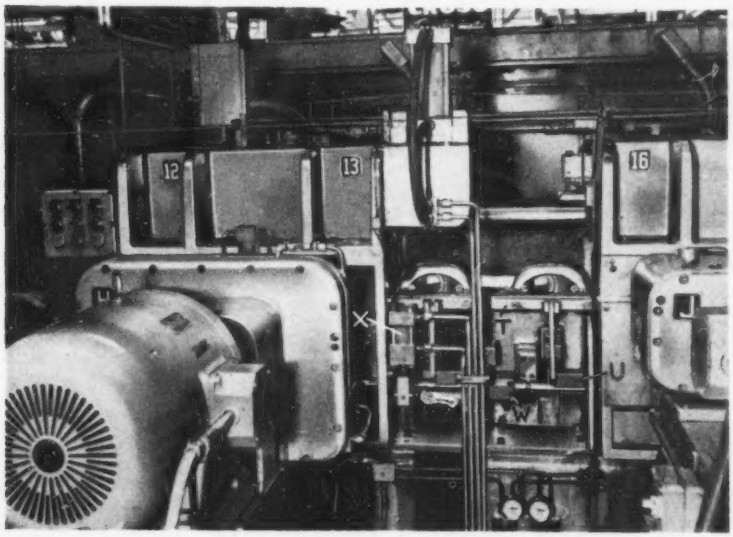


Fig. 9. After the Casting has been Turned Over, the Locating Dowels must be Moved Horizontally into Engagement, and this Movement is Effected by the Mechanism here shown

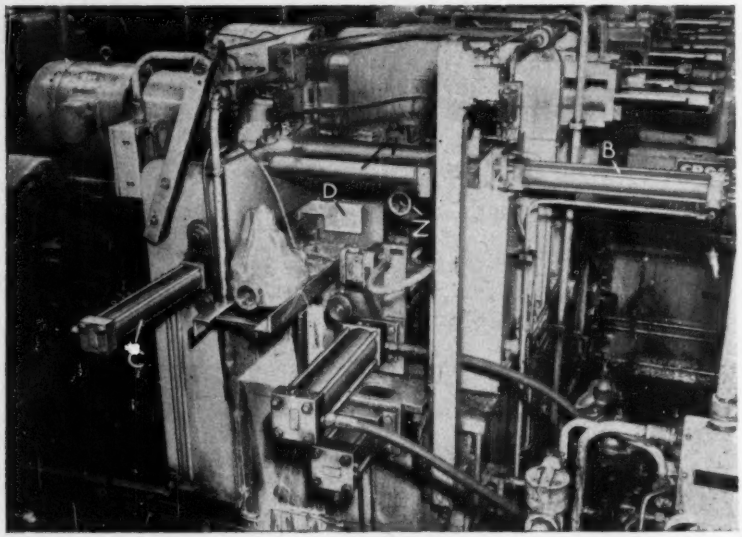


Fig. 10. At the Discharge End of the Cross Machine, the Casting is First Turned so that it Rests on its Cover Face, Before Being Moved to the Position Shown, for Removal by the Operator of the Next Machine

equipped with two 10-spindle adapters for drilling and chamfering the bolt holes in the cover face of the casting. These adapter spindles are driven at 1,255 r.p.m. and the head is fed at 5·6 in. per min. Boring operations on the outer end of the pinion housing *A*, Fig. 1, are performed by the head on the left-hand side of the machine, serving these stations. This head is seen in the foreground in Fig. 8, and the two spindles are equipped with cutters each having four inserted carbide-tipped blades.

The first of these cutters rough-bores the 1¾ and 2·104/2·109 in. diameters, faces the end to the 9·213/9·223 in. dimension, and cuts the chamfer, and the second finishes the 2·104/2·109 in. diameter. Spindle speeds of 351 and 327 r.p.m. are employed for roughing and finishing, with a feed rate of 4·5 in. per min. Following two idle positions, stations 16 and 17 are combined, and the two spindles of the right-hand head are fitted with combination cutters which rough- and semi-finish inner diameters of the pinion housing *A*, Fig. 1. The left-hand head is also equipped with combination tools, which are employed for machining the outside of the housing to 2 7/16 in. diameter, cutting the 45 deg. chamfer, and semi-finishing the remaining internal diameters in the outer end of the housing *A*, Fig. 1. For these operations, the spindle speed is 317 r.p.m., and the feed, 6 in. per min.

After passing two more idle stations, the castings reach station 20 where there is a head only at the right-hand side, equipped with ¼-in. by 28 U.N.F. 2B taps for the 10 holes in the cover face. Galtona (Richard Lloyd, Ltd.) taps are employed at a spindle speed of 993 r.p.m., and have a life in excess of 6,000 cycles. A further idle station (No. 21) follows, and the casting is then moved to the final position, at which it is automatically unloaded from the cradles on the transfer bar and discharged from the machine. The unloading station is shown in the view from the end of the machine in Fig. 10, where a casting may be seen on the discharge rails, ready to be removed by the operator of the next machine in the line. One of the bores of the casting which is held at the idle station can just be seen at *Z*, and when the transfer bar is next actuated, this casting is moved forward until it occupies a position directly beneath the two cylindrical bars *A*.

These bars carry a cross-head, which is connected to the ram of the long-stroke hydraulic cylinder *B*, so that it can be moved horizontally. Two arms on the cross-head project downwards to a point just below the casting, and in the edges of these arms there are slots of sufficient size to receive the axle-tube bosses of the casting. When a casting has been moved out on the transfer bar, the axle-tube bosses are held just in front of the slots in the arms, and oil is then supplied to the outer end of the cylinder *B* to move the cross-head to the left. As the cross-head moves, the slots engage the axle-tube bosses and push the casting out of its cradle towards the left. A roller on the transfer bar prevents the lower edge of the cover face of the casting from moving, and the casting is thus caused to turn in the slots until the cover face is horizontal and will clear the roller.

Another view of the unloading station, given in Fig. 11, shows the cross-head, after completing its movement towards the left, just starting the return stroke which takes place almost immediately. Movement of the cross-head to the left carries the

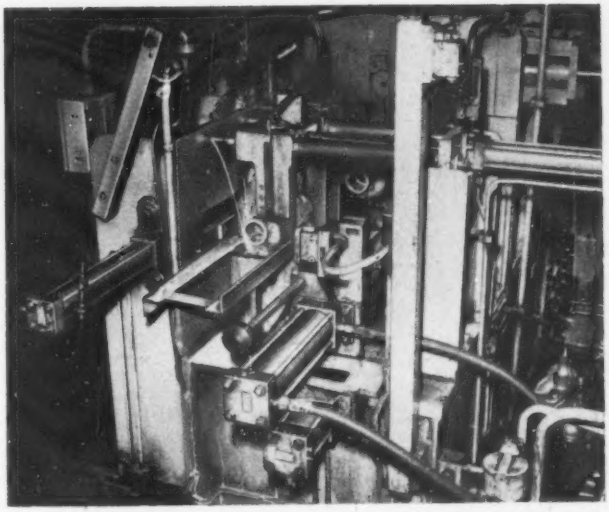


Fig. 11. A View Showing the Handling Mechanism at the Discharge End of the Transfer Machine, Immediately After the Piston in the Cylinder at the Right has Completed its Stroke

casting on to flat surfaces at the left-hand side of the transfer track, and it is discharged by means of the second long-stroke hydraulic cylinder *C*, Fig. 10, to the ram of which is connected the pusher *D*. The two hydraulic cylinders in the lower foreground in Fig. 10 and 11 provide for the vertical and horizontal movements of the transfer bar.

On this machine, the tools are lubricated and cooled with Cooledge (Fletcher Miller, Ltd.) soluble oil, and a spray of this fluid is applied to the casting, as it is moved out on to the unloading platform, to wash away any remaining swarf before it leaves the machine.

TOOL CONTROL ARRANGEMENTS

As for most of the other transfer machines installed in the Luton works, very thorough provision has been made for the maintenance of the cutting tools in good condition and, to this end, a control board is employed, as shown in Fig. 12. Of conventional layout, the board has spaces for the storage of a complete set of spare tooling for the machine. The spaces surrounding the holes for the various tools are lettered to correspond with letters on the various unit heads so that the tools can be readily identified. Adjacent to the tool-holding spaces, there are Toolometer dials graduated in divisions corresponding to 200 machine cycles. Each dial has a pointer which can be set to the number of cutting cycles normally completed by a tool before it requires to be sharpened. There is also a knob which is set to coincide with the pointer after a tool has been changed, and this knob is moved back towards the zero position at each machine cycle.

Thus, both the number of cycles for which the tool normally lasts, and the amount of life still remaining, are continuously indicated. When the knob reaches the zero position, the machine is stopped automatically and the head

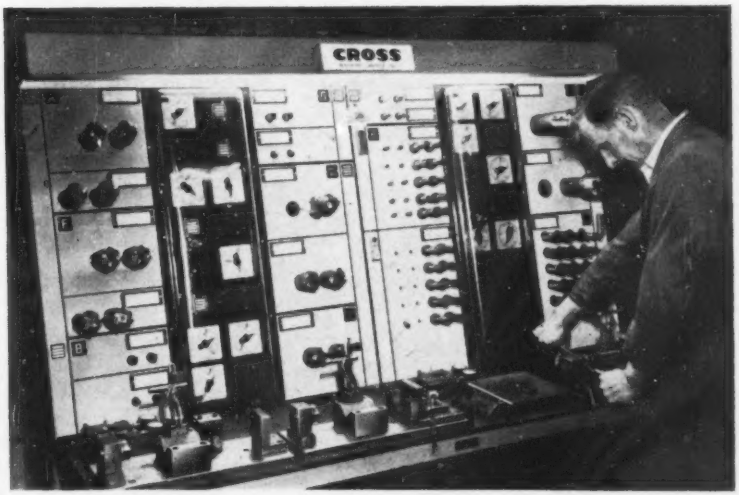


Fig. 12. Control of the Tooling Employed on the Cross Machine is Maintained with the Aid of this Board which Employs Toolometer Units to Indicate the Remaining Life of Each Tool

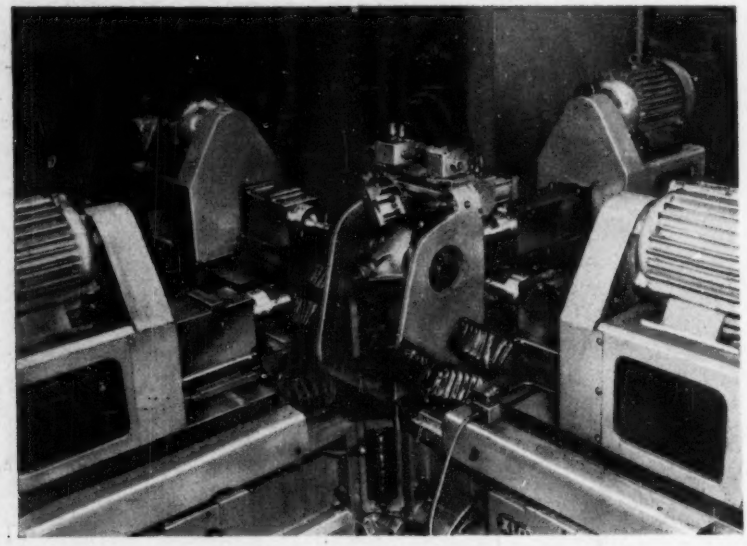


Fig. 13. Fine-boring of the Axle-tube and Differential Bearing Bores, the Inner and Outer Bearing Bores for the Hypoid Bevel Driving Pinion, and an Oil Seal Surface is Performed on this Ex-Cell-O 4-way Machine

on which a tool requires to be changed is indicated by a lamp on a central control panel. The Toolometer units are arranged in two rows and are enclosed by transparent plastics covers which can be locked to prevent unauthorized re-setting of the knobs. Only one operator and one setter is employed on the machine and the setter is seen in Fig. 12, engaged in adjusting one of the tools after re-grinding, ready for installation in the spindle, when required. Setting fixtures for all the tools are provided on the bench in front of the control board, and each has a V-block to accommodate the tool shank and a toggle clamp.

Normally, the adjustment required is only for setting length from one cutting face of the tool to the face of one of two locknuts on the shank, and dial gauges attached to special positioning blocks are provided for checking the settings. The closest tolerance held on the machine is 0·005 in., but the tools are set to finer limits. Tools are held in special collets in the machine spindles and are driven by square portions of the shanks. Details of the tool number, and the setting gauges to be employed, are given on a label attached to each tool-holding space on the board.

FINE-BORING OPERATIONS

From the unloading station of the Cross machine, the castings are transferred to the Ex-Cell-O No. 54, 4-way, precision fine-boring machine shown in Fig. 13. The four spindles of this machine are hollow, to enable coolant to be delivered directly to the cutting tool edges, and each is driven by a motor of 3 h.p. Spindle speeds are adjusted to give a cutting speed of the order of 350 ft. per min. and Cintride carbide-tipped tools are employed. The spindle at the right, and that opposite to it, provide for finishing the axle-tube and the differential bearing bores to the limits shown in Fig. 1, and are fed at 3·7 in. per min. The other two spindles finish-bore the driving pinion housing, the spindle at the left being equipped with two tools which operate on the 2·0452/2·0464-in. diameter for the bearing race and the 2·1865/2·1875-in. bore for the oil seal, at a feed rate of 2·3 in. per min. In the remaining spindle, there is a single tool for finishing the 2·8326/2·8338-in. bore for the inner bearing race, with a feed of 3 in. per min.

Details of the clamping arrangements for the casting in the central fixture on the Ex-Cell-O machine may be seen more clearly in the close-up view, Fig. 14. The casting is placed, initially, on the flat surfaces of two horizontal support brackets, with the cover face towards the vertical wall of the fixture, and is then pushed in until the location holes *E*, Fig. 1, are engaged by dowels which project from this wall. Lever-type clamps are next applied hydraulically at three positions on the casting, to hold it against the fixture wall, by pressing a button at the loading position, as seen at the centre in Fig. 13. One of these clamps, indicated at *F* in Fig. 14, is cranked so that it can apply pressure to the inside of the flange behind the cover face without interfering with the boring tools. Oil is supplied to the cylinder, on the far side of the fixture, which operates this clamp, by pressing the button mentioned, and when the clamp has been moved into position a micro-switch is actuated, to change the setting of a solenoid valve.

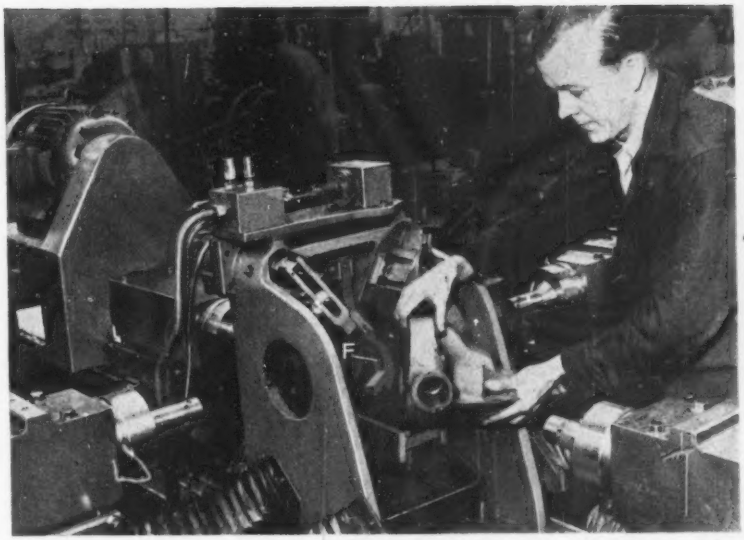


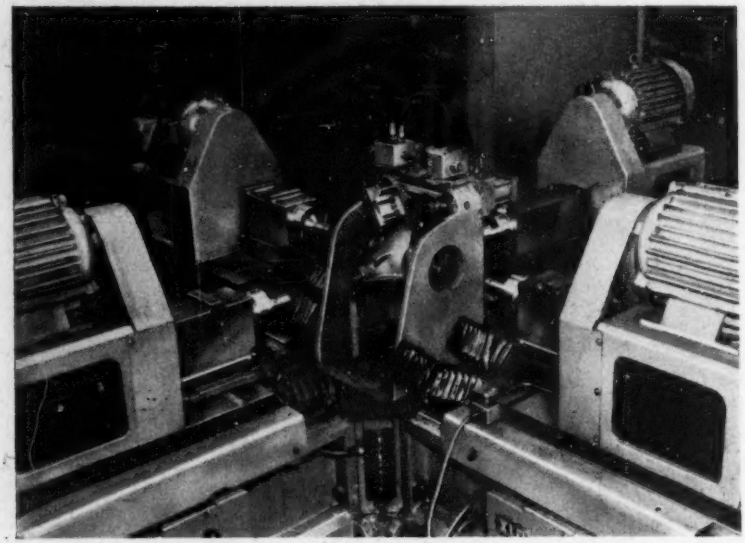
Fig. 14. The Flat Cover Face of the Casting is Clamped Hydraulically to a Vertical Wall of the Fixture on the Ex-Cell-O Machine, Pressure being Applied First to the Internal Clamp *F*

This solenoid valve then allows oil to pass to the two other clamping cylinders, to complete the clamping operation. The automatic machine cycle is initiated by pressing another button at the loading station, and after the spindles have been fed to depth, they are stopped and the heads are withdrawn in readiness for re-loading. Castings unloaded from the machine are placed on an inclined roller conveyor track, along which they travel to an automatic washing machine wherein oil and swarf is removed before they are inspected. This washing machine was supplied by H. R. Noble, and the washing fluid is passed through a band type filter unit for the removal of fine particles.

SOLEX INSPECTION EQUIPMENT

On emerging from the washing machine, the castings travel to the Solex inspection equipment shown in Fig. 15, which is employed to check the finished bore diameters. This equipment incorporates a horizontally-moving table, mounted on rollers for easy traverse, with two dowels to locate the casting, and a fool-proofing peg to ensure that it is not loaded the wrong way round. When the casting has been loaded, and the table pushed to the position shown, a valve at the front is operated so that air passes to a vertical cylinder beneath the table. This cylinder raises a pin into engagement with a hole in the table, to ensure that it is in the correct position for the gauging operation. At each side of the casting, in the position which it now occupies, there is a horizontal gauging head with two sets of jets for checking the diameters of the differential-bearing and axle-tube bores. After these heads have been advanced into the bores by

Fig. 15. All the Bores in the Axle Housing are Inspected with the Aid of this Special Solex Equipment. A Vertical Gauging Head Beneath the Table is Raised and Rotated by Air Cylinders



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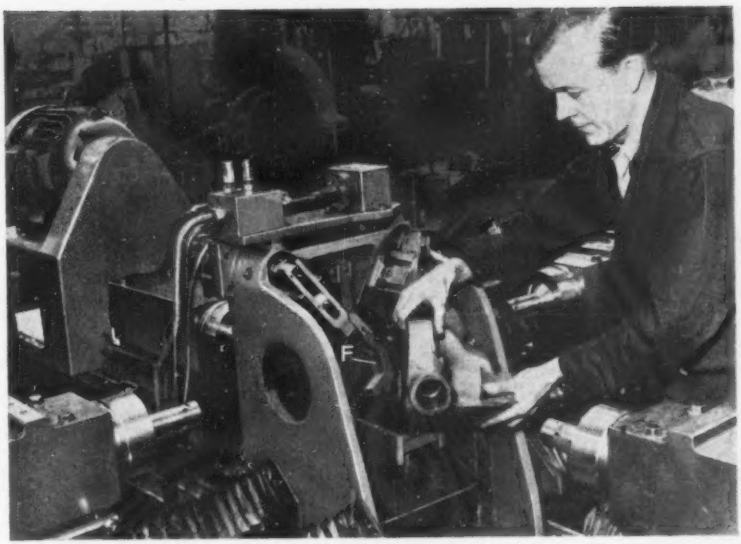

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hand, they are turned so that the bores can be inspected for ovality.

A counter-balanced ram above the casting carries another gauging head which is employed to check the oil seal and outer driving pinion bearing diameters, and this head, also, is advanced by hand and turned to check for ovality. Beneath the casting there is another head which is raised by an air cylinder, controlled by a pedal-operated valve, to check the inner pinion bearing bore. This head can also be rotated, for an ovality check, by means of a horizontal air cylinder controlled by a valve at the front of the machine. The cylinder ram is connected to a rack, the teeth of which engage with a pinion on the gauge head. Neither of the cylinders for the gauging head beneath the table can be operated unless the locating pin for the table has been raised into engagement.

After inspection, the axle tubes are pressed into position, as seen in the heading illustration, on a special Weatherley Oilgear horizontal press. Temporary stops are fitted in the bores *B*, Fig. 1, and the casting is then loaded, cover face downwards, over a locating bracket. Angular location of each axle tube is taken from the spring bracket, previously welded into position, and the tubes are supported in cradles between the central fixture and the hydraulic ram at each end of the machine.

A drilling machine is then employed to drill-ream ½-in. diameter holes through the axle tubes in line with the dowel-location holes *E*, Fig. 1, and short retaining pins are fitted to hold the axle tubes in place. Another hole, to receive an oil breather, is also drilled at this stage, and the axle casing is then ready for final assembly. Some stages in the assembly, also the production of axle tubes, half-shafts, and hypoid bevel driving pinions, will be described in a future article.

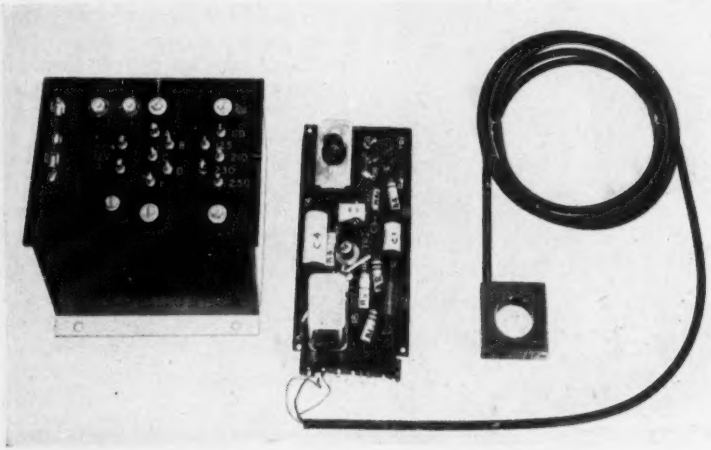
Airmec Tool Alarm Unit

Shown in the figure is a tool alarm unit, developed by Airmec, Ltd., High Wycombe, Bucks., which detects the breakage of steel tools such as drills, reamers, and taps, and immediately switches off the machine. Known as the type N263, it is particularly intended for application to transfer and other types of special-purpose automatic machines, where the breakage of one tool can result in expensive delay and possible damage.

Small detector coils, moulded in Araldite, are fitted around the tools to be protected. These coils are connected by means of flexible armoured cables to transistor alarm units, which plug into sockets in the main machine control cabinet. The alarm units are printed circuit boards whereon are mounted all the components, including a sealed output relay.

Immediately a tool breakage occurs on the machine, a signal is passed from the corresponding detector coil to its alarm unit, and the output relay is energized. The relay contacts can be used for tripping the main power contactors and, in addition, for switching alarm circuits.

Two types of coils are available, covering tools from ⅛ to ¾ in. diameter, and No. 60 drill size to ⅜ in. diameter, and power supplies for the alarm units are provided by the Airmec No. 267 power pack, which has a D.C. output of 12 volts 1 amp., and is capable of operating as many as 10 units.



Airmec Type N263 Tool Alarm Unit Which Will Detect Breakage of Steel Tools and Switch-off a Machine

Equipment for the Economical Batch Machining of Large Parts

A manufacturer of road-building equipment in the U.S.A. is employing special multiple-purpose machines of unusual design to enable comparatively small batches of heavy weld-fabricated steel parts and castings to be economically produced. Four of the six special machines, all of which were built by the W. F. & John Barnes Co., Rockford, Ill., have multiple tooling mounted on hydraulically-operated turrets. The spindles on the various heads only rotate when the heads are indexed into the machining position opposite the work-holding fixture, an arrangement of dogs, selector switches, and contactors being employed to achieve this result, and the need for numerous slip rings is thus avoided.

By carrying out many operations on one machine, important savings in both machining and work-handling time are obtained. Economy has also been achieved by designing certain of the machines to handle more than one part. These features also permit substantial savings in floor space requirements. It has been estimated that with the four turret-type machines there was a reduction in equipment costs of as much as 50 per cent, and in floor space, of 80 per cent. These machines were built specifically for processing road-building equipment components, but the same design principles could be economically adapted for batch-production workpieces which are either larger or smaller.

On one of the special turret-type machines, shown in Fig. 1, a 6-station rotary table is provided for the tooling, and the work-holding fixture is mounted on a shuttle saddle. This machine is used for operations on three welded steel casings (a right- and left-hand casing of one size, and a larger casing) and the top cover plates for each of the casings.

A total of three interchangeable work-holding fixtures is provided: one for the right- and left-hand casings, the second for the other casing, and the third for all three cover plates. Only three of the six tooling heads are used for any particular casing or cover. Each head has from 27 to 35 spindles, and tools are provided for drilling, reaming, chamfering, counterboring, tapping and milling operations. Loading of the workpiece requires approximately 3 min., and unloading, 2 min. At 100 per cent efficiency, 6·55 cases or 9·05 covers can be completed per hour.

The cast-iron rotary base is provided with an extra finished flange (at 120 deg. to the flange to which the work saddle base is attached) for the possible future addition of another work base, if production requirements make it necessary. Hardened and ground steel ways are provided for the shuttle saddle on which the work-holding fixture is mounted. The fixture saddle is powered by a Barnes floor-mounted hydraulic unit and has three feed rates, switches being provided to engage the feed movements at the correct positions.

The 96-in. diameter rotary table weighs about 40 tons when equipped with the heads, motors, spindles, and bushing plates. A power-operated locating pin is provided for the indexing table. Because the machine is designed with stationary

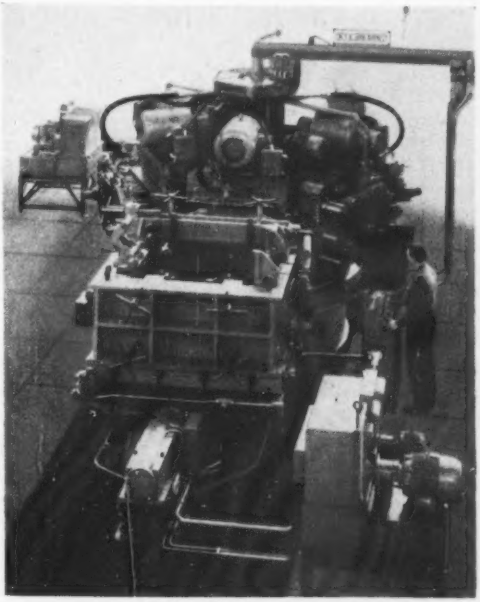


Fig. 1. This Turret-type Machine has Multiple Tooling Mounted on a 6-station Rotary Table and the Work is Held in a Shuttle Fixture

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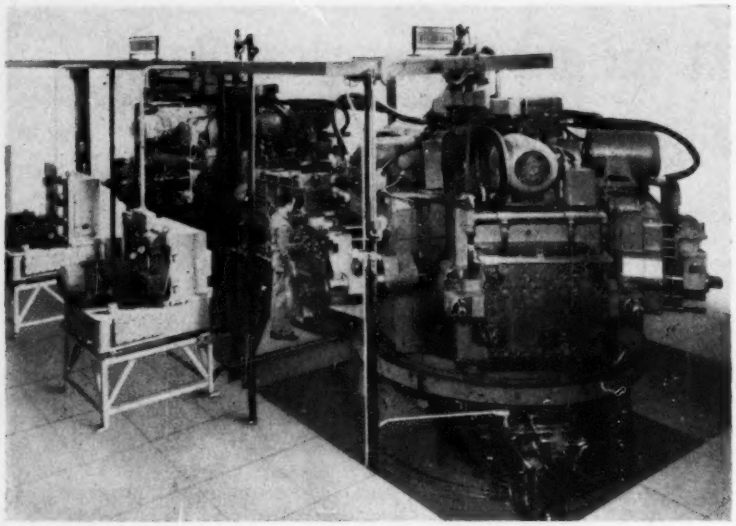


Fig. 2. Two 5-station Rotary Tables, One at Each End of a Shuttle Work-holding Fixture, are Employed for this Special Machine. Three Hydraulic Units are Incorporated, Two for Indexing the Rotary Tables and One for Traversing the Fixture

heads (the tapping heads are equipped with individual lead-screw controlled spindles), only two hydraulic units are required. One unit is employed to index the rotary table, and the other, as previously mentioned, for the work feed.

On another of the special turret-type machines, seen in Fig. 2, two 5-station rotary tables are provided (one at each end), and the shuttle work-holding fixture is mounted on ways between them. The same three casings processed on the machine previously described are also handled on this second machine. Operations performed by the various multi-spindle heads include drilling, boring, reaming, chamfering, counterboring, and tapping. The arrangement is shown diagrammatically in Fig. 3, and the number of spindles in the various tool heads ranges from 17 to as many as 53. Loading and unloading times are approximately the same as before and 2·90 cases can be completed per hour at 100 per cent efficiency.

The shuttle-type fixture is equipped with locating blocks and clamps for the special work-holding pallets used on this machine. Each casing is located in a pallet by means of four retractable dowels and three milled spots, and is clamped manually before the pallet is loaded into the shuttle fixture. Three hydraulic units are employed on this machine, one for indexing each of the rotary tables, and the third for feeding the work.

Another variation of the same basic turret design has been adopted for a third special machine, as shown in Fig. 4. Here, a centrally-located 6-station

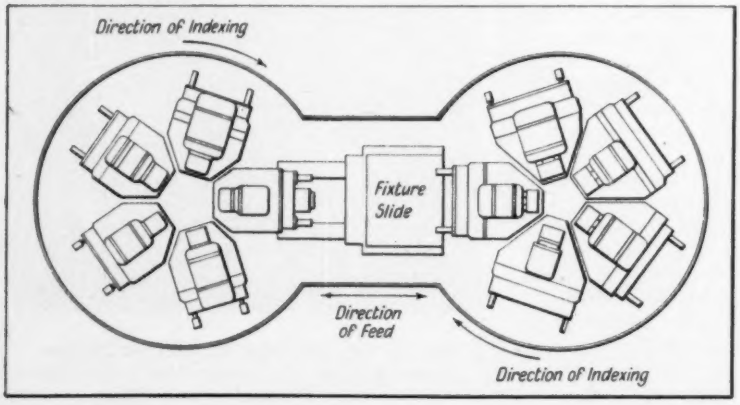


Fig. 3. Diagrammatic Plan View Showing the Layout of the Indexing Tool Heads and the Fixture Slide on the Machine Illustrated in Fig. 2

rotary table is used, and two shuttle-type work-holding fixtures are provided, one at each end. This machine also handles the same three casings, as well as two different gear covers. Operations performed include drilling, boring, chamfering, and tapping, and the numbers of spindles in individual heads range from four to 21. A close-up view of one of the 4-spindle boring heads, equipped with throw-away type carbide tooling, is shown in Fig. 5. A surface finish of 50 micro-inches is specified for the main bore surfaces, and a tolerance of 0·001 in. is maintained on diameters and centre spacings.

One saddle carries a fixture which accommodates the two special work-holding pallets used on the previous machine. The opposite saddle has a fixture for holding the two gear covers, which are located from the contours of the castings. Pallets holding the casings are transferred from the previous machine with the work still clamped in position. Casings are completed at the rate of 4.73 per hour, and gear covers, at five per hour (at 100 per cent efficiency).

The fourth special turret-type machine (Fig. 6) has a 4-station rotary table and one shuttle-type work-holding fixture and is employed for operations on two different gear covers. One head on the table has a single spindle which is tooled for chamfering and facing one of the gear cover surfaces. Another has 25 spindles, each carrying a drill. A third head has 29 spindles, all of which are used for chamfering and 18 for spot-facing. The fourth is equipped with 14 tapping spindles. Loading and unloading of the work each require 0·90 min., and both gear cover parts are completed at the rate of 5·9 per hour, at 100 per cent efficiency.

As with the previous machines, an extra finished pad has been provided on the cast-iron rotary table base for the possible future addition of another fixture saddle base. The fixture saddle is equipped with a Barnes hydraulic unit that provides two feed rates forward and one in reverse. For tapping, which is performed with individual lead-screw controlled spindles, the saddle is traversed forwards and locked. Similarly, for the generating-type facing operation, the saddle is traversed forward to a positive stop. After this stage, the saddle returns, and the positive stop can be manually adjusted to a second position to enable a second facing cut to be taken.

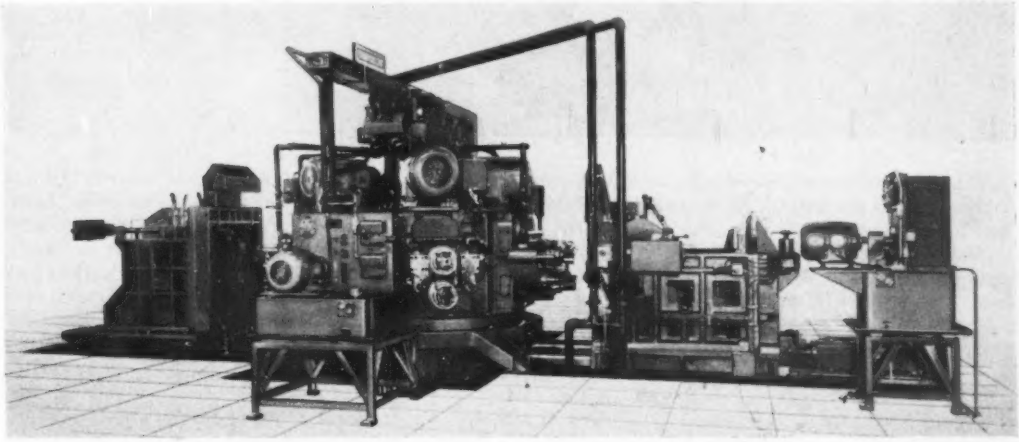


Fig. 4. Three Welded Steel Casings and Two Gear Covers are Processed on this Machine which has Two Shuttle-type Work Fixtures

The other two special machines, which were also built by W. F. & John Barnes, are of in-line shuttle transfer type. On both machines, the fixture saddle is power-indexed along horizontal ways by means of a geared-head, clutch-brake motor, which drives heavy roller chains looped over sprockets. Accurate location of the saddle at each working station is obtained by means of hydraulically-operated, wedge-type index bars.

One of the shuttle-type machines, illustrated in Fig. 7, has five stations, and is equipped with three vertical and two horizontal heads with numbers of spindles from two to 30 for drilling various holes in four different welded steel roller frames. Loading and unloading of the frames, which weigh

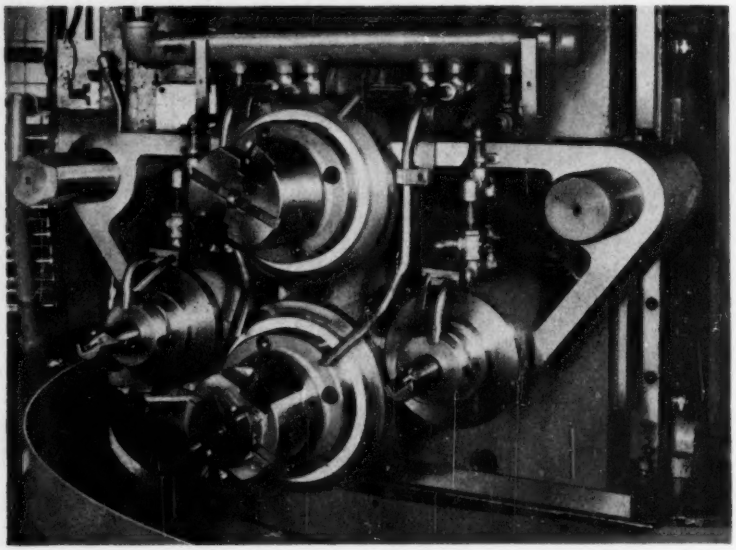


Fig. 5. Throw-away Type Carbide Tools are Used on this 4-spindle Boring Head Employed on the Special Machine Shown in Fig. 4. A Tolerance of 0·001 in. is Maintained for the Diameters and Spacing of Holes Bored by this Head

2,700 lb. each, require 5·50 min., and 2·81 parts are completed per hour with the machine working at 100 per cent efficiency.

The universal work-holding fixture is built as part of the saddle, and is provided with various bases and surfaces for mounting locating blocks and clamp brackets to accommodate frames of different lengths. Workpieces are located from half-round surfaces and the previously milled side faces. Locating and clamping are both effected manually. Tool guide-bushings are carried by the individual machine heads, and interlocks are provided to prevent the saddle from being indexed until the bushing plates are in the retracted positions.

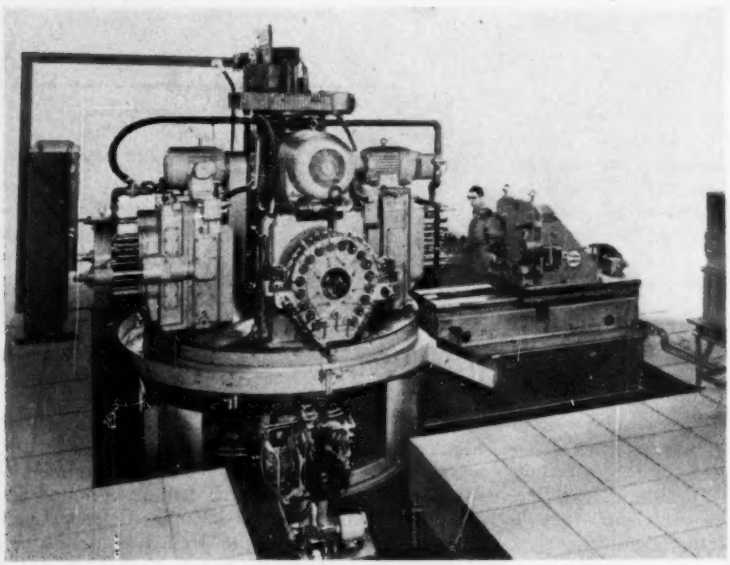


Fig. 6. A 4-station Rotary Table and One Shuttle-type Work-holding Fixture are Employed for Machining Two Different Gear Covers for Road-building Equipment. The Heads on this Machine Incorporate a Total of 87 Spindles

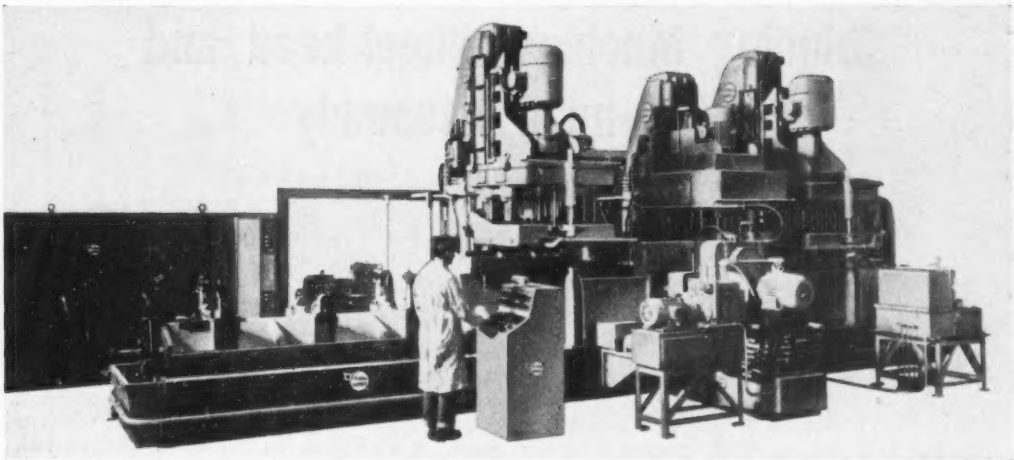


Fig. 7. This 5-station, Shuttle-type Machine has Three Vertical and Two Horizontal Heads for Drilling Various Holes in Four Roller Frames

The second shuttle transfer machine (Fig. 8) has seven stations and six horizontal heads for drilling, boring, facing, chamfering, and tapping two different cast-steel frame parts. Loading and unloading each require 5 min. and 3.25 parts are completed per hour. As much as ½ in. of stock is removed from parts of the casting during boring, for which 75 h.p. is required.

Electrical controls on all machines are built to JIC standards, and each machine is equipped with a Barnes Electro-Graphic Detector. This wired-in checking system enables faulty electrical components and failures in the electrical control circuits to be rapidly located. Individual hydraulic units also conform to JIC standards. The bases of the machines are arranged so that the coolant and chips flow into a chip conveyor, and the coolant enters tanks in the floor.

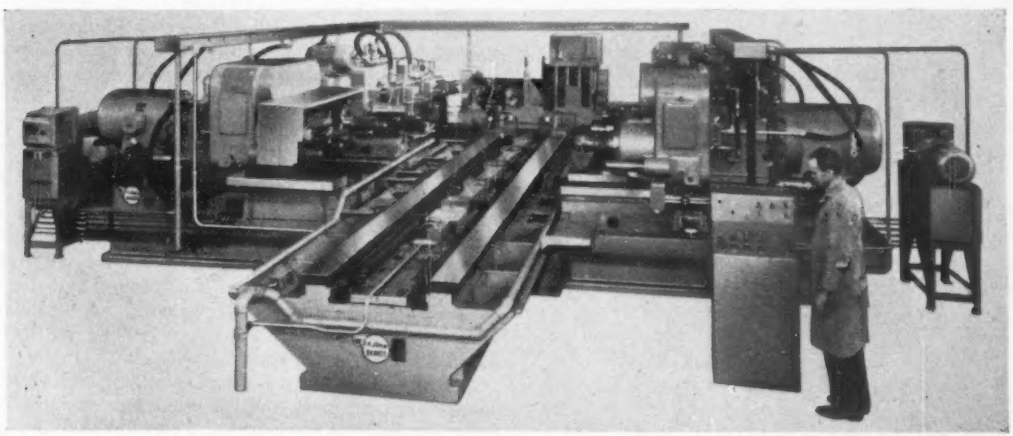


Fig. 8. Cast-steel Frame Parts for Road-building Equipment are Drilled, Bored, Faced, Chamfered, and Tapped on this 7-station Shuttle-type Machine

Grinding Machine Wheel-head and Work-head Assembly

Methods Employed by A. A. Jones & Shipman, Ltd.

The extensive specialized experience of A. A. Jones & Shipman, Ltd., Narborough Road South, Leicester, in the design and construction of grinding machines, has shown that one of the most important factors influencing performance is roundness of the wheel-head and work-head spindles. Typically, the Nitralloy spindles for the firm's range of machines are hardened to a Vickers D.P.H. value of 1050 to 1100, and are ground to a circularity tolerance of 0·000012 in. Surface-finish is maintained within 4 to 6 micro-inches, for satisfactory oil-retention, and parallelism is held within 0·00005 in. per 12 in. Accuracy on diameter, it may be noted, is less critical, since the bearings are scraped to the spindles, and in this instance the tolerance is 0·0005 in. Concentricity of the various diameters, and the squareness of the faces, are, however, held within 0·0001 in., total indicator reading.

Originally, these standards were maintained by the use of a process known as "supergrinding,"

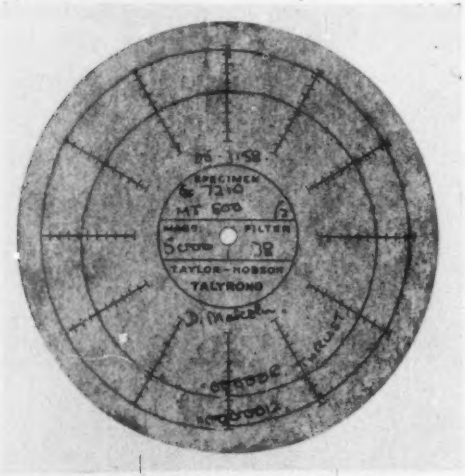


Fig. 1. Typical Talyrond Record of a J. & S. Grinding Wheel Spindle with Maximum Deviations from Circularity of 0·000008 in. and 0·000012 in., at Opposite Ends

for which a special rig was used. This rig comprised a standard machine base, with a wheelhead and workhead driven by belts from a countershaft, to minimize transmitted vibration. With the same object, the hydraulic unit was mounted externally, on the shop floor. Steplessly-variable speed control was obtained electronically. All the machine spindles, however, are now ground on a standard J. & S. type 1305 cylindrical machine, which is employed exclusively on this work. As received, the spindles are initially 0·00025 in. oversize, and before they are finish ground, the centres are lapped on a J. & S. type 1600 lapping machine. For this purpose, a diamond-dressed grade A220-T5 V90 Carborundum mounted point is employed.

On the cylindrical grinder, the work is held between carbide centres, and is driven at 150 r.p.m. against the rotation of the wheel, which is run at 1,500 r.p.m. The 14-in. diameter, grade AA 120 JV60 Carborundum wheel is 1½ in. wide. Grinding is carried out by the dead centre method, and by taking the lightest possible cuts. Hand feed is employed, and after each advance, the work is allowed to spark out completely, before the next increment of feed is applied. The coolant is Edgar Vaughan's Hocut soluble oil, at 40:1 dilution, which is circulated through a Philips continuous-band type paper-element filter unit. During grinding, the work is periodically checked for size with a micrometer reading to 0·0001 in., and on removal from the machine, is checked with a Sigma comparator.

When the spindle has been ground to size, it is checked for roundness on a Taylor, Taylor & Hobson Talyrond machine, and it is usually found that the circularity attained by the use of the grinding technique described is within 0·000005 in. to 0·000012 in. If it is found that the work is out of tolerance, it is reground. A typical record, taken at a magnification of 5,000× on the Talyrond machine, is shown in Fig. 1. The component in question was a wheel-spindle, which was checked at both ends, and the maximum deviation from circularity at the thrust end was 0·000008 in., and at the opposite end, 0·000012 in. It is pointed out that this standard is regularly attained with the grinding machine working under normal shop

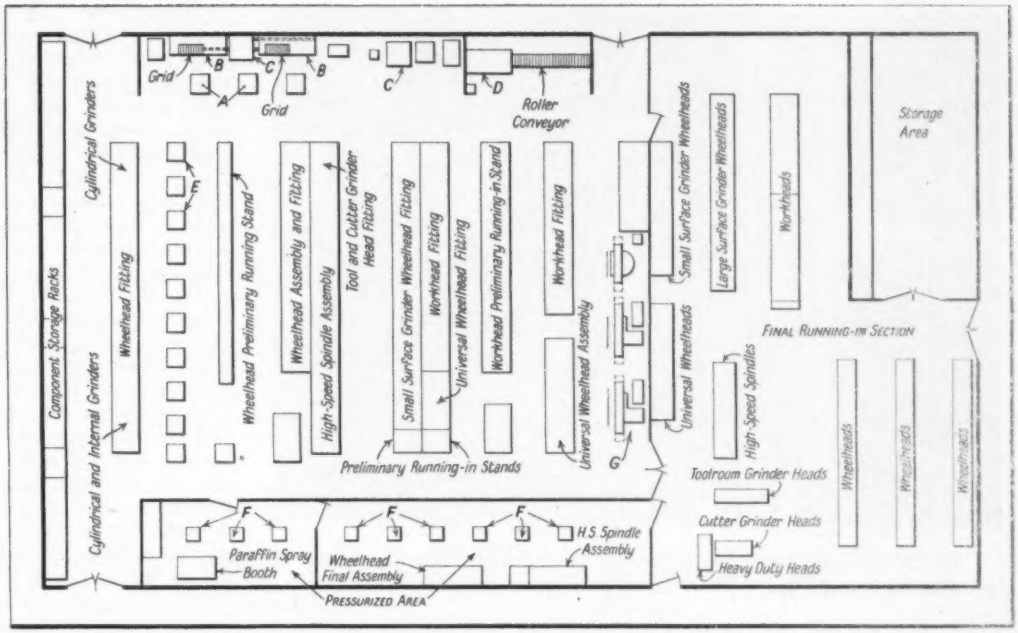


Fig. 2. Diagram Showing the Layout of the Wheel-head and Work-head Assembly Section

conditions, without temperature-control, and without employing a highly skilled operator.

ASSEMBLY

To provide optimum conditions for the assembly of wheel-heads and work-heads, commensurate with their accuracy and performance, the company has recently reorganized, completely, the section of the factory devoted to this exacting work. Originally, this section was situated in an open area of the shop, which has now been isolated by enclosing it in glazed steel partitioning. In planning this reorganization, the following aims have been borne in mind: to enable assembly to be carried out under conditions of scrupulous cleanliness; to permit closer control and co-ordination of the entire assembly procedure; and to provide improved working conditions.

The enclosed area of 5,040 sq. ft. is subdivided by further partitions into five sections, devoted to general assembly, dismantling, final assembly, running-in, and storage. To prevent the ingress of dust, felt strip is fitted beneath all partitioning, and all doors are provided with seals. Panels of heat-insulating material have been installed in the roof, in order to stabilize the temperature, and to minimize dust. The dismantling and final assembly sections are situated in an area that is temperature-controlled, and pressurized with filtered dust-free air, provided by a unit designed and constructed by the company. This unit, which incorporates a Vokes Multivee filter, provides 10 changes of air per hour. The slight positive pressure maintained in the area ensures that no unfiltered air can enter when the doors are opened. As further precautions against dust, the operators wear clean, white coats. Tissue paper is employed for cleaning in preference to rags, and smoking is banned.

This wheel-head and work-head assembly department is organized and equipped to deal efficiently with a number of different types of units. The range includes 11 types of wheel-heads, for machines ranging from small surface-grinders mounting 7-in. diameter by ½-in. wheels, to heavy-duty cylindrical grinders with 24-in. diameter by 6-in. wheels. There are two types of work-heads, of 8-in. and 10-in. capacity, and all these heads are equipped with plain bearings. In addition, the department handles two sizes of ball-bearing heads, for cutter-grinders, and three sizes of high speed grinding spindles—also with ball bearings—for internal

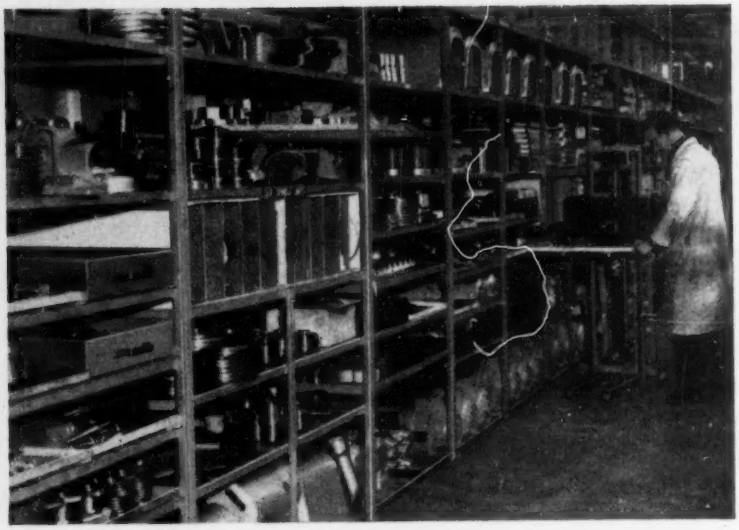


Fig. 3. Components are Drawn from the Storage Racks, Here Shown, and Handling is Facilitated by Small Sherpa Fork-lift Trucks, One of which is Seen in Use

grinding attachments, die-grinding, and similar duties. The reconditioning of all these types is also carried out, for which the procedure is the same as for new assemblies.

SHOP-LAYOUT

The general layout of the shop, which is designed for an orderly flow with a minimum of handling, is shown diagrammatically in Fig. 2. Components are issued in sets from the main stores, and are transferred to storage racks in the general assembly area by means of special trolleys designed and built by the company. These racks, some of which are shown in Fig. 3, have compartments that are allocated to specific components. Small components are handled on trays, which are loaded directly into the compartments, and withdrawn, when required, by the operators on the fitting lines. Larger items, which cannot conveniently be dealt with in this manner, are handled in the normal way. For the general handling of work throughout the section, small Sherpa manually-operated hydraulic fork lift trucks (Salisbury Precision Engineering Co., Ltd.) are employed, one of which is being used in Fig. 3 for the withdrawal of a tray.

The storage racks are within easy reach of the general assembly section, and a smaller bay, termed the "preliminary" fitting section, to which are confined all operations of a dust-creating nature. These operations include drilling and tapping, de-burring and chamfering main castings, trimming aluminum guards, and scraping. The equipment in this section comprises benches, drilling machines, grinding and polishing heads for cleaning and blending castings, and an abrasive belt machine for general flat scurfing and polishing. On the larger components, operations such as scraping and fitting are facilitated by the use of Tilturn tables, *A*, Fig. 2 (Dean, Smith & Grace, Ltd.), which, as their name implies, can be tilted and turned in any direction, for access to all sides of the work. The latter is secured by bolts in T-slots, and the tables are mounted on castors so that they may readily be moved.

Although the preliminary fitting is not isolated from the general assembly area by partitioning, safeguards are provided against the dispersion of dust into that area. For example, each of the fitting benches, (*B*, Fig. 2) is equipped with a grid, over which the vice is mounted, as shown in Fig. 4. All filings and dust which would normally fall on the bench-top, or become air-borne, are drawn through the grid by air-extraction trunking, to a Dallow-Lambert Dustmaster dust collector unit (*C*, Fig. 2). Similar equipment is provided for the various machines, and, in this way, virtually all dust is eliminated at the source. In Fig. 4, it may be noted, one of the dust collector units is seen at the extreme right, and in the lower left foreground may be observed one of the Tilturn tables. To facilitate the handling of heavy components in the preliminary fitting section, a rail hoist is also provided.

Where appropriate, components that have passed through the preliminary fitting section are taken to an adjacent cleaning and painting area, in which there is a Mann Egerton rotary-jet paraffin spray wash booth *D*, Fig. 2. Here, the main castings are cleaned, and are subsequently

placed on a section of roller-track, where they are dried and painted. From this point, they are transferred to the lines in the general assembly section, by means of one of the small Sherpa fork-lift trucks mentioned earlier. The general assembly section is arranged in such a manner as to minimize the movement of operators and work, to make the most economical use of the available floor space, and to permit assembly on a line basis. As may be observed in Fig. 2, the various lines are disposed at right-angles to the preliminary fitting section, and parallel with the component storage racks, across the width of the area. In the interests of cleanliness, no work is allowed to be placed on the shop floor, and the areas beneath all benches are accessible for cleaning.

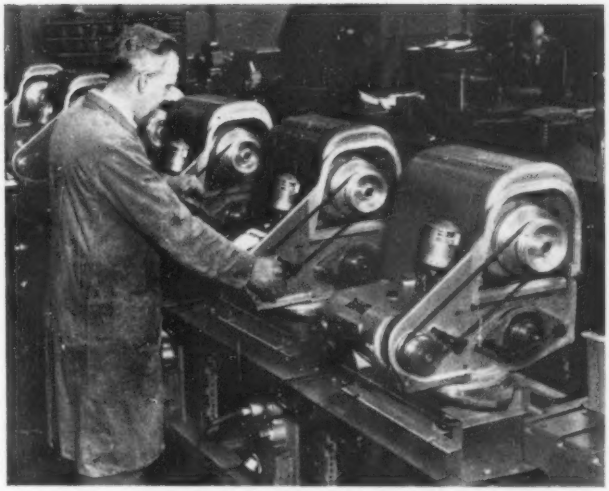


Fig. 5. Typical Stations in the Wheel-head Preliminary Running-in Line, in the General Assembly Area. The Spindles are Run for Four to Five Days

WHEEL-HEAD ASSEMBLY

The general assembly section comprises two main areas, one of which is devoted to wheelheads and high-speed spindles, and the other to work-heads. Typically, the procedure for wheelhead assembly is as follows. All groups of components that can conveniently be pre-assembled to form sub-assemblies are built-up on a batch basis, by conventional bench methods, to maintain a buffer stock. These sub-assemblies include such items as oil pumps, motor drives, and wheel-guards, which, after being tested where necessary, are placed in the component storage racks earlier mentioned. They are then withdrawn from these racks to the assembly lines, as required.

Fig. 4. At the Benches in the "Preliminary" Fitting Section, Dust is Removed through Grids, and Air-extraction Trunking is Installed Beneath the Vices, as Here Seen

Meanwhile, major items such as the wheel-head main castings are received from the preliminary fitting section with the spindle bearings already in position and diamond bored to a hgh degree of accuracy.

In the general assembly section, it may be noted, a line of fitting benches is provided, parallel with which there is a line of Tilturn tables *E*, Fig. 2. Here, the end-thrust faces of the castings, at the spindle bearings, are scraped and lapped, and the covers are fitted and lapped. Following this stage, these items are transferred to the paraffin spray booth in the preliminary fitting area, for thorough cleaning, and when they have been returned to the assembly section, the spindles are "let in" to the bearings. This operation consists of fitting the bearings to the spindles by blueing and scraping, and is carried out with the work mounted on the tilting tables.

The remaining operations of fitting the spindle end-thrust pad, the oil pump, oil pipes, filter-unit and motor drive, and building-up the complete assembly, are also carried out with the work mounted on the tilting tables. In this instance,

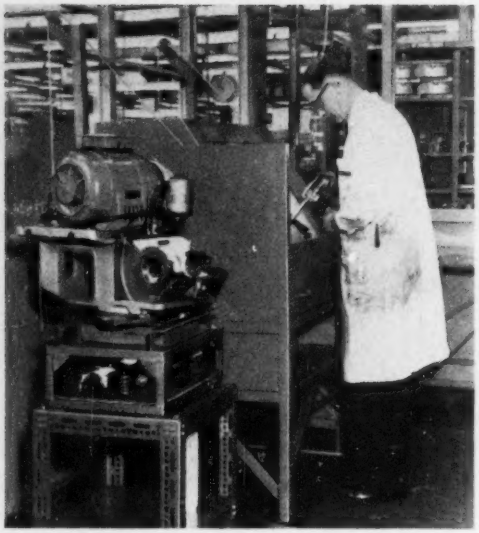


Fig. 6. This Booth, in the Pressurized Dismantling Section, is Employed for Cleaning the Components with a High-pressure Paraffin Spray. One of the Special Cradles Used During Rebuilding May be Seen at the Left

however, the work is attached to a special pallet, which is interposed between the base casting and the tilting table. These pallets, which facilitate handling the assembled heads with the fork lift trucks, are so designed that each will accommodate several different types, and the heads remain on them throughout all but the final stages. As each wheel-head assembly is completed, it is moved across a narrow gangway, to one of the stations of the preliminary running-in line shown in Fig. 5, where wheelheads for type ETU machines, which incorporate both internal and external grinding spindles are seen.

In this line, there is a series of 10 stands constructed from Dexion slotted angle, each with a steel plate top, and provided with connections and a switch for 3-phase, 440-volt electrical supply. Dexion angle, it may be noted, is used extensively throughout the department for such purposes. On the preliminary running-in line, each wheel-head is run for four or five days, under the supervision of a patrolling inspector and the fitter concerned. Throughout this period, a careful check is maintained on the condition and performance of the bearings, and if necessary, they are further scraped and fitted. Once the inspector is satisfied that the assembly is correct in every respect, including the "marking" of the bearings to the spindle, the end-thrust, and the fit of the various guards and covers, the latter are removed and painted. In order to indicate the particular unit to which these items belong, they are suitably marked.

STRIPPING AND CLEANING

Meanwhile, the oil is drained from the well of the spindle housing, and the unit is transferred to the dismantling room in the pressurized section, for stripping and cleaning. Here, all items relating to the spindle assembly are stripped-down to the basic details, which are thoroughly cleaned with a high-pressure paraffin spray, in the special booth shown in Fig. 6. An Enots Cleanmaster gun is used, which operates on a supply pressure of 80 lb.

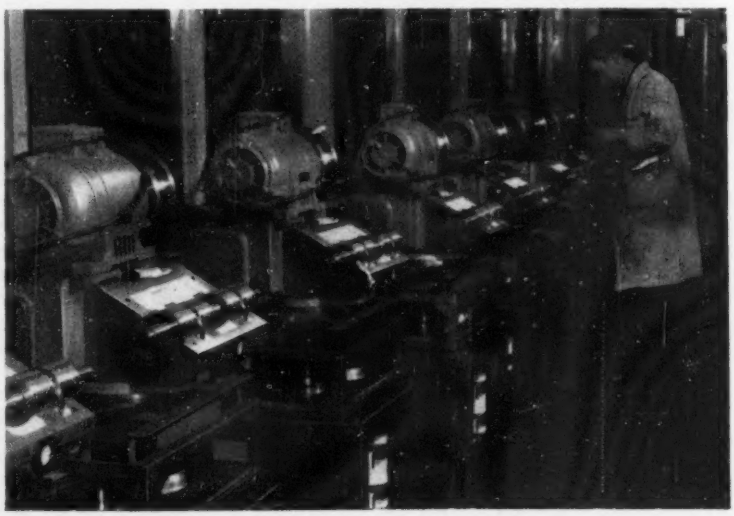


Fig. 7. View of Part of the Final Assembly Section, also in the Pressurised Area, Showing Typical Wheel-heads in Course of Re-assembly

per sq. in. Designed and built by the company, the booth is totally enclosed by a hinged, counter-balanced cover, and the nozzle of the gun is inserted through a narrow slit in a large Perspex window. The paraffin is drawn from a 3-gallon tank, the contents of which are frequently changed, and is delivered in the form of a powerful jet of fine mist. This mist condenses on the walls of the booth, and drains into a tray, whence it returns to the tank.

The entire head is also treated, with the driving motor suitably protected, particular attention being devoted to the oil well of the spindle housing. As each detail is cleaned, it is blown dry with an air-jet, and placed in a special cradle also seen in Fig. 6. Fabricated from rolled steel angle, the cradle has an upper recess that accommodates and locates the pallet on which the head is supported. In the bottom, there is a flock-covered plywood board, on which the various details are laid, and profiled blocks are provided, to carry the spindle. As may be observed, the cradle is supported at a convenient height on a stand of Dexion angle, several of which (*F*, Fig. 2) are employed throughout the pressurized area.

With the cleaned components thus conveniently kept together in complete sets, they are transferred, by means of another Sherpa fork-lift truck, to the adjacent final assembly section, part of which is shown in Fig. 7. This section, which is also in the pressurized area, is isolated from the dismantling section by a partition and communicating door. The fork truck, it may be noted, is always kept within the pressurized area, so that the risk of introducing dirt or dust from outside is minimized. The work of final assembly is performed by skilled operators, who at the same time keep a close check on general quality and finish, and who have authority to reject any components not considered satisfactory. During this stage, every care is taken to ensure that all fitting is of the highest standard. Once the units have been assembled, they are transferred to the final running-in section, which will be described later.

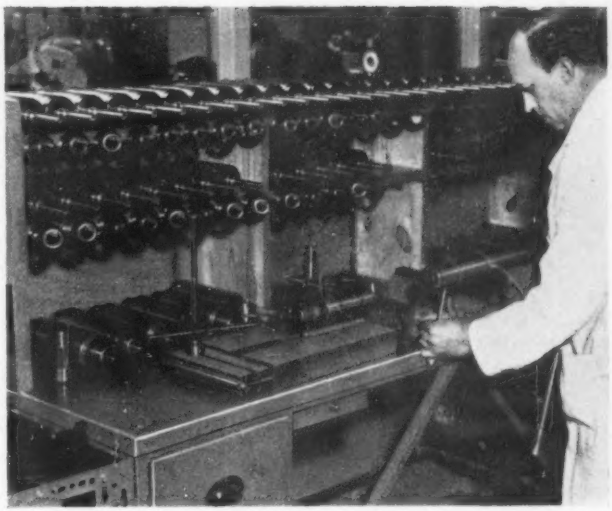


Fig. 8. View of a Special Assembly Bench for High-speed Spindles, Showing Peg-type Storage Racks, for Keeping the Matched Components in Sets, and a Dial-gauge Fixture

HIGH-SPEED SPINDLES

The procedure for assembling the high-speed spindles is generally similar to that for wheel-heads, except that the parts are selectively assembled as a bench operation. Because of the high speeds at which they run, the spindles call for an exceptionally high standard of accuracy, both dimensionally, and in fitting. On an average, there are 14 faces to each spindle, all of which are held within 0·0002 in. at the grinding stage. Before selective assembly, all the components are washed in paraffin, and matching is facilitated by measuring them on a Sigma comparator. Once matched, they are marked for identification, so that they can be kept together, in the selected sets. For this purpose, electric etching is employed, in order to avoid any distortion which might be caused if the identifying symbols were stamped.

Following this stage, the spindles are transferred to the dismantling room, in the pressurized section, where they are stripped down, and the components cleaned with the high-pressure paraffin spray earlier described. Final assembly is carried out at the specially-designed bench shown in Fig. 8, under conditions of cleanliness that are, if anything, even more rigorous than for wheel-head assembly. As may be observed, peg-type racks are provided, on which the components are hung in the matched sets. Before they are assembled, all components are thoroughly washed in Esso No. 10 solvent, which is contained in a small fireproof tank mounted on the left-hand end of the bench, and just visible in the bottom left-hand corner of Fig. 8.

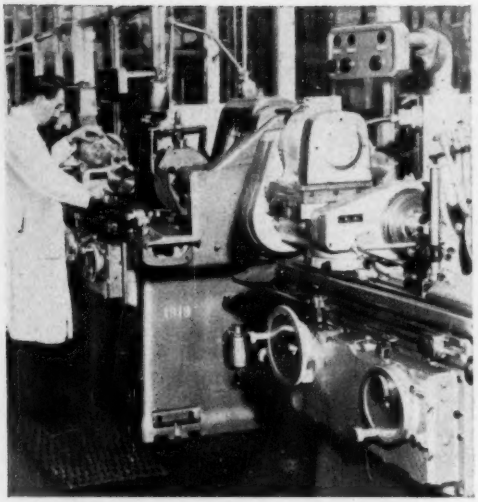


Fig. 9. After Final Assembly, Work-heads are Set-up, Checked and Tested, on Standard J. & S. Machines, Two of which are Here Seen

During assembly, a careful visual check is maintained on general quality, and a number of dimensional checks is also performed with the aid of simple dial-gauge fixtures, one of which may be seen in Fig. 8. Before the front cover is fitted, the rear of the spindle bore and the rear cover are checked for distortion, and the concentricity of the pulley is also checked within 0·001 in., total indicator reading. For assembling the pulley, a collet-type tool is employed for holding the opposite end of the spindle while the nut is tightened, and this tool is seen in Fig. 8. After the pulley has been checked for concentricity, a test bar is inserted in the spindle nose taper, and a minimum of four readings is taken at different angular positions, to check for alignment. For the two smaller sizes of spindles, the test bar is 3½ in. long, and at this distance from the spindle nose, the error must not exceed 0·0005 in., t.i.r.

The auxiliary spindle is next inserted, and secured by means of the drawbar, after which the front cover is fitted. In the firm's machine lines, it may be noted, these auxiliary spindles are ground concentric and true, between centres, within 0·0001 in. t.i.r. Once the units have been completely assembled, they are prepared for test running by filling them with Edgar Vaughan's Kensington high speed oil, at a special rig whereby the oil is delivered through a Micronic filter. This rig, and a dispenser for paper cleaning tissue, are situated next to the solvent tank at the end of the bench. After filling, each spindle is test run in the final running-in section for a minimum of 4½ hours, at a speed of 11,000 to 60,000 r.p.m., according to type. During this period, careful checks are made for any sign of overheating, roughness or vibration. Subsequently, the cases are polished, and the units are inspected. During this inspection stage, the various checks performed in the final assembly room are repeated.

Where appropriate, the spindles are test-run on the particular machines for which they are intended, before despatch. Until recently, the units were packed in specially-designed steel boxes, but this practice was abandoned, as it was sometimes found that, despite this precaution, they sustained damage in transit. Instead, they are now packed in a special bonded wood-fibre composition known as Resil, supplied by the Pontefract Box Co., Ltd. The pack takes the form of a pair of matching blocks, in each of which there is a half-cavity that snugly fits the external form of the unit, and the material is of a light, porous, resilient nature, so that effective protection is afforded against shocks and blows. This method of packing is more economical than that originally employed, and the packed units can now be subjected to the roughest handling without damage.

WORK-HEADS

The procedure for work-heads is, again, generally similar to that for wheel-heads, except that the units are built-up directly on the same type of pallets, on the preliminary running-in stands. These stands resemble those employed for the wheel-heads, and their position in the assembly area, and that of the adjacent fitting benches, may be seen in Fig. 2. As each head is completed, it is run-in for half a day, and is then stripped down, cleaned, and re-assembled, in the pressurized section. Before final running-in, it is set up on one of a number of standard J. & S. machines in the main assembly area, for a series of checks and tests under normal operating conditions. Two of these machines are seen in Fig. 9.

The various checks carried out are as follows. A test bar is inserted in the spindle nose taper, and the alignment and concentricity are checked with a dial-gauge, which is engaged with the test bar at a distance of 6 in. from the spindle nose. The total indicator reading obtained when the spindle is revolved must not exceed 0·0005 in. Two grinding tests are performed, for circularity and face squareness. For the first, a bar of 1½ in. to 2 in. diameter is cylindrically ground, and must not show a deviation from roundness greater than

0·00005 in. For the second, a 3-in. diameter face is ground, and must be within 0·00005 in. t.i.r. for squareness. A faceplate squareness check is also carried out, and the error on an 8-in. diameter faceplate must not exceed 0·0015 in., t.i.r.

Another check, at which the total indicator reading must not exceed 0·0005 in. at a distance of 6 in. from the spindle nose, is carried out with a test bar in the nose taper, and with the driving plate in position. This check serves to verify that the driving plate does not adversely affect the accuracy of the spindle by distorting it. Corresponding accuracy checks are carried out on the chuck and chuck jaws, and it is ascertained that the various mechanical details of the head, such as the angular setting lock, are functioning correctly. The lock is checked by aligning the head, by means of a test bar, parallel with the table edge, inserting a bar between centres, and fully tightening the tailstock. There must be no perceptible movement of the bar, as ascertained by means of a dial-gauge.

Fig. 11. This Stand, for Running-in J. & S. Type 540 Surface Grinder Wheel-head Spindles, Accommodates a Number of Units at Two Levels

All relevant details of the assembly are carefully inspected, and the unit is then transferred to the final running-in section, where it is run-in for 4½ days. Subsequently, it is set up on the machine for which it is intended, and a series of grinding tests is performed.

The general layout of the final running-in section may be seen in Fig. 2, and a typical view, showing some of the special equipment installed, is given in Fig. 10. Running-in stands, constructed mainly from Dexion angle, and designed to suit the various different types of heads, are provided with individual switchgear and power supplies. In appropriate instances—for example, on the stands for running-in the wheel-heads for some of the larger surface grinders — pumps for supplying lubricating oil are also incorporated.

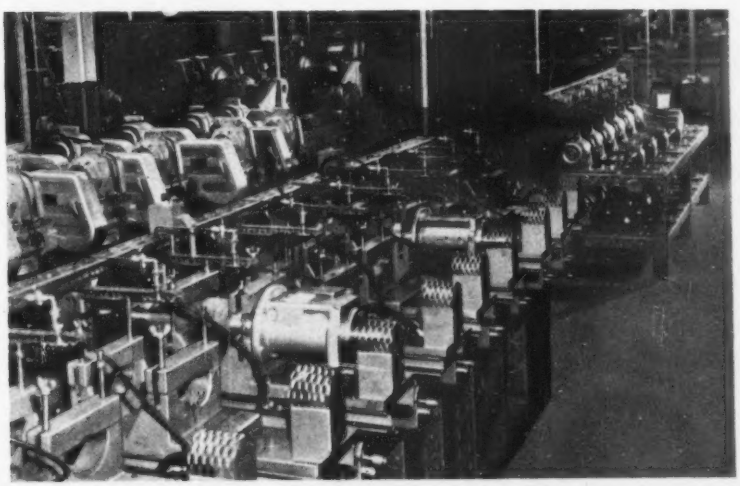


Fig. 10. General View in the Final Running-in Section, Showing Typical Running Stands

If the assembly has a built-in driving motor, the latter is employed for driving the spindle, but on the stands for some of the smaller units, such as the wheel-spindles for the firm's type 540 surface grinder, and the high speed

spindles, separate 1-h.p. driving motors are provided.

A typical stand, for type 540 surface grinder wheel-spindles, is shown in Fig. 11. As may be observed, it affords capacity for a large number of units, which are accommodated at two levels. All stands, except those for the high speed spindles, seen in the foreground in Fig. 10, are fitted with automatic overload cut-outs. In the event of a spindle stalling due to seizure, the motor concerned is thereby switched off, and coloured warning lamps are automatically illuminated. The length of the running period varies according to the nature of the unit, and, as already indicated, the high speed spindles are test-run for 4½ hours, whereas the work-head spindles are run-in for 4½ days.

The wheel-head spindles are subjected to a total of 10 to 14 days intermittent and continuous running. Throughout the running period, all units are kept under close observation by an inspector, who periodically enters on a chart full particulars such as the speed, temperature, and time. At the end of its run, each unit is transferred to an adjacent storage area, for withdrawal as required.

Trucks for Supplying Small Parts for Assembly

The Chance Vought Aircraft, Inc., U.S.A., have recently put into operation the tractor-drawn "train" seen in the accompanying figure, for supplying various small items, such as nuts, bolts, screws, washers, rivets, and gaskets, to the work areas in the assembly shop for F8U Crusader aircraft and Regulus guided missiles. The train comprises three trailers, which provide a total of several hundred trays for storing different items of the types mentioned above. In all, six trains are kept in continuous operation.

At night, the trains are driven along the central gangway of the shop, and individual trays from the assembly areas on each side are brought on hand trucks, as seen at the right in the figure, to be re-filled. During the day-time, the trains are parked in special areas, and fitters can visit them to obtain further supplies without the use of conventional requisition slips.

Each train is replenished from the main stock room once per week. A system of coloured tabs has been adopted throughout the plant to afford an indication of the quantity required of any particular item. A white tab on a tray indicates that it is to be filled, and green and red that it is half- and quarter-filled, respectively.

The use of these trailers has reduced the amount of material which is stored on the shop floor, and relieved the congestion which occurred at the serving windows of the stores. It is estimated, moreover, that by eliminating the writing, checking, and filing of approximately 40,000 stores requisition slips per month, the company has effected a saving of 15,720 man-hours per year.

Tractor-drawn Train of Three Trailers for Supplying Small Items in an Assembly Shop

Automatic Assembly Machines for Roller Skate Wheels

In MACHINERY, 90/25—4/1/57 reference was made to the Trans-O-Mator and Intermittor units developed by the Ferguson Machine & Tool Co., Inc., P.O. Box 5841, St. Louis, Mo., U.S.A. Two machines, based on these units, have recently been supplied for the automatic assembly of different types of ball bearing roller-skate wheels, from sheet steel pressings. A rotary Intermittor type machine is used for one design of wheel, for which three parts, together with eight balls, are assembled and secured to form a complete unit. For a more elaborate design of wheel, in which ten parts, together with two sets of balls, are assembled, an in-line Trans-O-Mator machine is employed.

The rotary machine is shown in Fig. 1 and consists of the standard base, and a 36-in. rotary table having seven operating stations. Fig. 2 shows the sequence of assembly. At the first station the centre spindle *A* is positioned by a horizontal slide and inserted in the assembly nest by a vertical air-operated ram, and the table then indexes to bring this nest to the second station, where the outer-shell *B* is fed from a hopper and inserted in the nest, again by a pneumatic ram. Eight balls, as indicated at *C*, are hopper-fed into a seating in the outer-shell at the third station, and successive indexing movements of the table bring the assembly nest beneath the fourth and fifth stations, where the inner-web *D* is hopper fed and inserted by pneumatic ram, and a hydraulically-operated tool turns in the upper-edge of the outer-shell, so that the entire assembly is secured. At station 6 the assembled wheel is ejected, and at station 7 a check is made to ensure that the nest is empty. The automatic cycle is controlled by limit switches, and an output of 30 assembled wheels per min. is

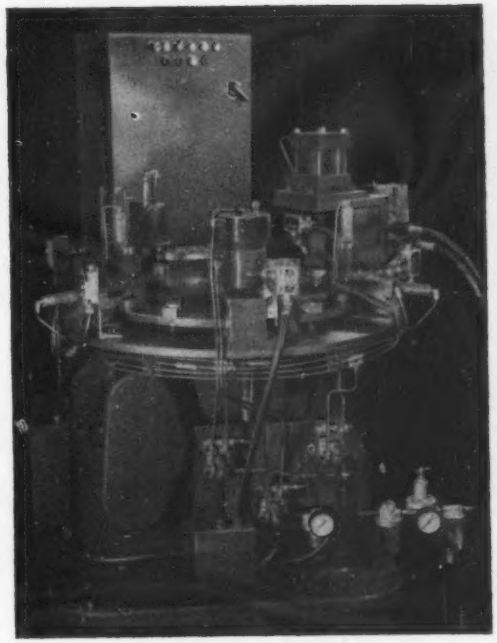


Fig. 1. Standard Ferguson Intermittor Base and 36-in. Rotary Table Fitted with Special Tooling for Automatic Assembly of Small Ball-bearing Wheels. The Hoppers for Feeding the Components are Not Shown in this Illustration

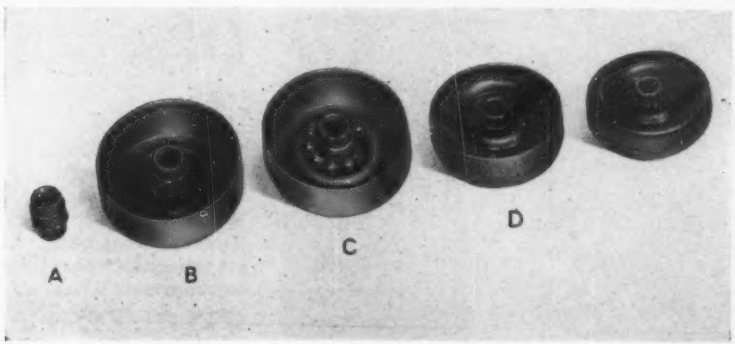


Fig. 2. The Various Stages of the Automatic Assembly of Roller Skate Wheels Performed by the Machine in Fig. 1 are Here Shown. A Completely - assembled Wheel is Seen at the Right

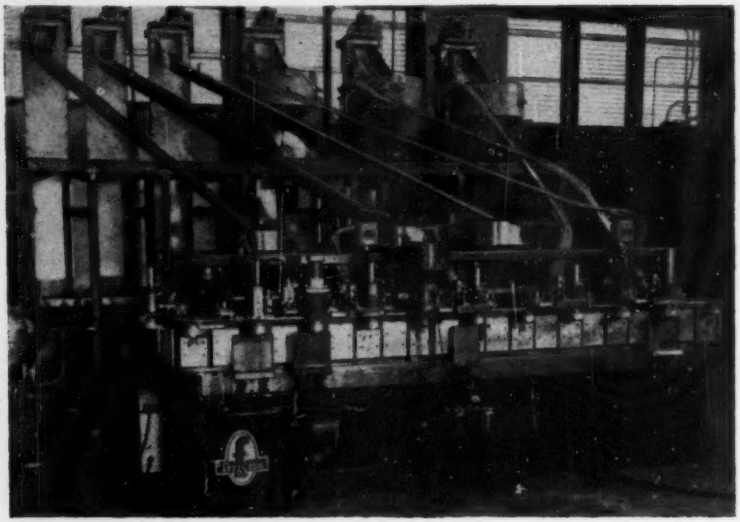


Fig. 3. Standard Ferguson Trans-O-Mator Straight-line Transfer Unit with a Component Storage Installation and Special Tooling for the Assembly of a Larger Type of Ball-bearing Wheel

obtained. The machine is shown in Fig. 1 with the tooling installed but without the feed hoppers for the various parts.

THE TRANS-O-MATOR MACHINE

The Trans-O-Mator machine for the more elaborate wheel has 14 working stations, at three of which forming operations are carried out on different parts during the stages of assembly. Fig. 3 shows the machine, complete with the special tooling, and with the component storage and feeding unit at the rear. When the contents of the various hoppers reach a certain minimum they are automatically replenished by means of magnetic conveyor belts which raise components from storage containers below. The transfer conveyor carries nest fixtures, in which the wheels are progressively assembled, and is indexed in an anticlockwise direction as viewed from above. At the first three stations, at the front and at the left-hand end of the machine, a split centre sleeve is delivered and positioned in the nest, one end of the sleeve is flared by an air-operated ram, and the first bearing half-cone is pressed on to the sleeve.

Next, at station *E*, Fig. 4, ten balls are fed from a hopper into the assembly, and distributed around the seating in the half-cone by means of a vibrating mechanism. The balls are then enclosed by a bearing retainer which is assembled at station *F*, Fig. 4.

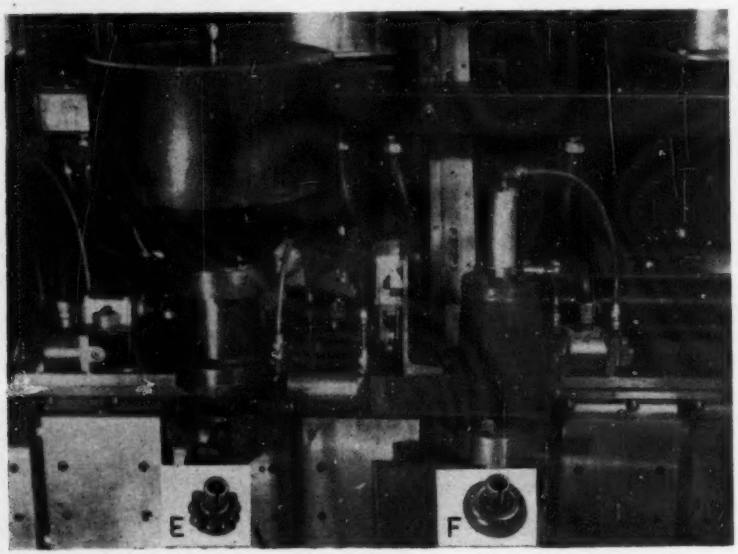


Fig. 4. At Station *F*, Ten Balls are Hopper-fed and Positioned on the Bearing-seat by a Vibrating Mechanism, and at Station *E* the Bearing-retainer is Hopper-fed and Positioned Over the Balls

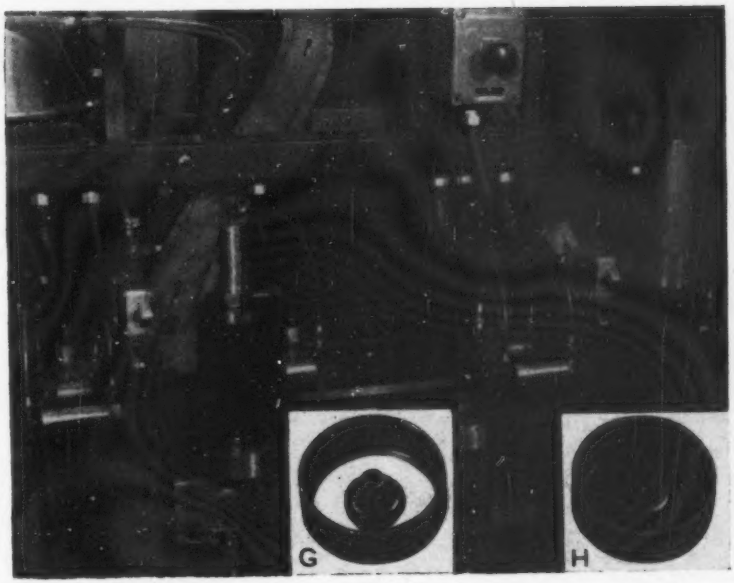


Fig. 5. The Tyre-tread is Delivered from a Hopper on Top of the Storage Unit and Pressed into the Assembly Nest at station *G* by Means of an Air-operated Ram. At the Next Station, the Lower-web is Inserted

The small parts which are assembled at the first and third stations, and at stations *E* and *F*, are delivered from hoppers mounted on the machine, whereas the larger parts, namely the tyre tread and the lower- and upper-webs, are supplied from Syntron hoppers seen mounted on top of the storage unit in Fig. 3. Assembly of the tyre tread and lower-web takes place at stations *G* and *H*, Fig. 5. The tread is separately located in the nest and is joined to the inner assembly when the web is pressed into position. Subsequently, the transfer conveyor turns through 180 deg., and the assembly nests pass along the back of the machine.

The next station *K*, Fig. 6, is therefore at the rear, and opposite to station *H*. As can be seen in Fig. 3, the upper-webs, for assembly at station *K*, are delivered from the left-hand Syntron hopper of the storage unit, and they are pressed into place by an air-operated ram.

The upper-bearing retainer, to be assembled at station *L*, Fig. 6, is identical with the lower-bearing retainer, which was previously assembled at station

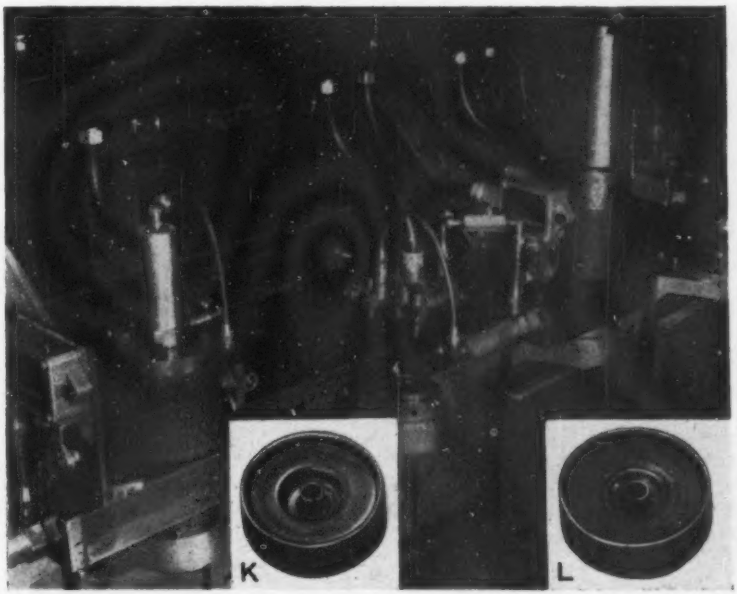


Fig. 6. After the Upper-web has been Hopper-fed into the Assembly and Pressed into Position at Station *K*, the Upper-bearing Retainer is Delivered from the Same Hopper which Serves the Third Station

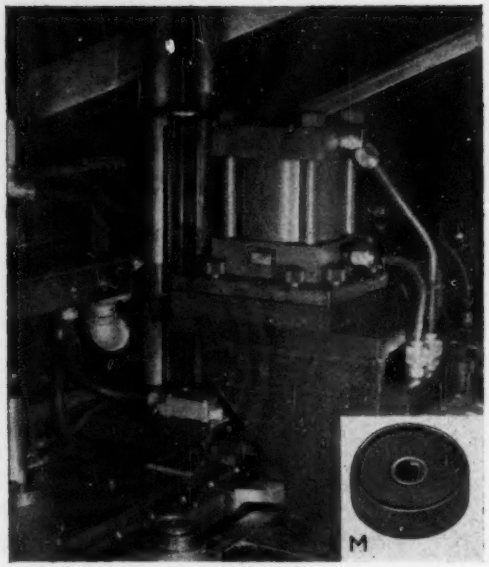


Fig. 7. The Dust-shield is Fed into the Assembly Nest from a Magazine at Station *M*. A Hydraulic Ram then Swages the Upper End of the Centre Sleeve and an Air-operated Impact-hammer Peens the Edge of the Tyre Tread

F, Fig. 4. Both these operating stations are fed from a common hopper, and the delivery chute leading to station *L* has a 180-deg. twist, to ensure that the parts are delivered with the bearing seat uppermost. At the adjacent station, this bearing seat receives ten balls, delivered from the hopper which also serves station *E*.

An upper half-cone is next assembled. This part is identical with the lower half-cone which was previously assembled at the third station, and, once again, a common hopper serves front and rear stations, a 180-deg. twist in the delivery chute providing for inversion of the parts delivered at the rear.

At station *M*, Fig. 7, a dust shield is fed from a magazine and inserted in the upper end of the tyre. With the shield held in position by means of a magnet, an air-operated ram swages the upper end of the centre sleeve over the edge of the half-cone which was last assembled. Finally, an air-operated impact hammer, at the same station, peens the upper-edge of the tyre on to the dust shield, and this operation completes the assembly of the wheel.

When the assembly has been indexed to the next station, it is raised from the nest on a central spindle which is moved upwards by a cam. Subsequent indexing movement carries the wheel between lipped rails whereby it is retained when the central spindle is forced back into the nest fixture at the last station. The completed wheels are moved progressively along the rails to the delivery point.

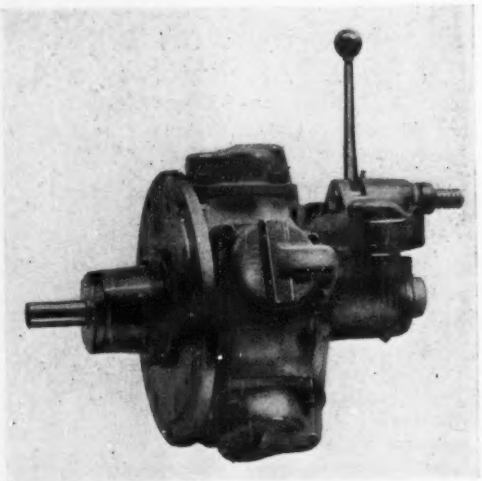
Before being turned through 180 deg. in readiness for the next cycle, the empty nest is automatically checked to ensure that the entire assembly has been removed.

Globe 10-h.p. Radial Air Motor

The range of air motors made by Globe Pneumatic Engineering Co., Ltd., Ashton Road, Harold Hill, Romford, Essex, has recently been extended to include the 5-cylinder radial unit, here shown, which develops 10 h.p. at a speed of 600 r.p.m.

Intended for operation by compressed air at 80 to 100 lb. per sq. in. pressure, the new motor has a diameter of 18¼ in., and the length, excluding the driving shaft, is 15⅝ in. It is available for foot and flange mounting, and may incorporate a reversing control valve of new design, which permits accurate adjustment of the steplessly-variable shaft speeds.

The crankcase of this motor is pressurized to prevent escape of lubricant, and the crankshaft is mounted in ball bearings. The big-end bearing is of the needle roller type.



Globe 10-h.p. Radial Air Motor

Craven 150-in. High-speed Precision Gear Hobbing Machine

The high-speed precision gear hobbing machine shown in Fig. 1 has been designed and built by Craven Brothers (Manchester), Ltd., for Metropolitan-Vickers Electrical Co., Ltd., Manchester. Intended primarily for operations on turbine gears, the machine is capable of operating at speeds up to five times those normally associated with such work, and will permit investigation of the application of advanced high-speed hobbing techniques (such as are now used in commercial gear-cutting) to the production of turbine gears. In view of these requirements, the machine has been fitted with a 30-h.p. driving motor, and anti-friction bearings have been provided throughout the main gearbox, and for all other high-speed shafts.

The design incorporates a number of refinements based on the experience of the company's own research departments, and other sources. Representatives from the D.S.I.R., Mechanical Engineering Research Laboratory inspected the machine in the company's works to apply the Grade A limit (B.S. 1498—1954) tests, as laid down by the B.S.I. for hobbing machines of this type. The machine conformed to this specification, and the accumulated pitch errors in the master wheel, and in spur and helical test gears, were well within the permissible.

This machine is of the moving-column/fixed-table type, and has a capacity for spur and helical gears from 4-ft. 9-in. to 12-ft. 6-in. diameter, with face widths up to a maximum of 4 ft., using a vertical hob feed motion. Hobs up to 9 in. diameter can be employed, the speed range being steplessly variable betwen 18 and 150 r.p.m. Gears with any number of teeth, up to a maximum of 1 000 and including prime numbers, can be cut, and the arrangement is such that when helical gears are being hobbed the feed can be stopped and started, the rate of feed changed, or rapid traverse for the hob-slide engaged, without interference with the helix angle. The column can be adjusted along the bed either by hand or power, and power feed for in-cutting is also provided for feeding in to depth when machining double-helical gears which

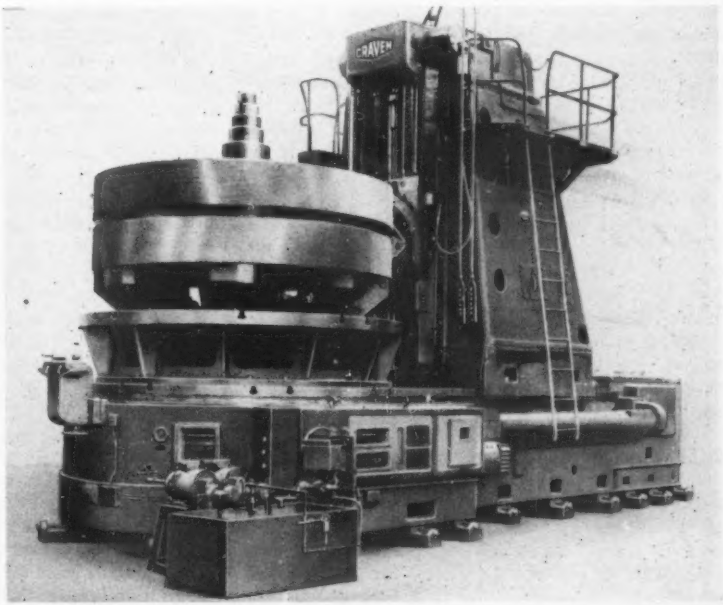


Fig. 1. General View of the Craven 150-in. High-speed Precision Hobbing Machine for Large Turbine Gears. There are Two Master Worms and Wheels Beneath the Worktable, One for Roughing and One for Finishing Operations, and Pressure Oil-flotation is Provided to Carry Part of the Weight of the Table and Workpiece

have a narrow gap between the two face widths. Pressure oil can be introduced between the slideways of the column and the bed, by means of a hand-operated pump, in order to relieve the weight of the column when it is being traversed by hand, or rapidly by power.

Of 10-ft. diameter, the work-table is carried on a large-diameter cast iron spindle, which is mounted in pressure-lubricated bearings, also of cast iron. This spindle has a 2-ft. 6-in. diameter bore, to accommodate the lower end of the shaft on the workpiece. The work-table is supported on two concentric annular tracks on the upper surface of the machine bed, and a certain amount of the combined load of the table and the workpiece can be carried by oil under pressure in an annulus between these two tracks. Oil pressure is determined according to the weight of the work, and is set by means of an adjustable valve and a pressure gauge. By relieving the table guiding surfaces in this manner, the load on the master worm drive to the work-table is greatly reduced.

The pressure oil also serves to lubricate the table bearing surfaces, the spindle bearings, and the table driving worms and wheels, of which there are two, as will be explained later. The oil is delivered from one of a pair of identical, separately-driven pumps, the other serving as a reserve unit which is automatically started should the first fail to function at any time. Both pumps draw their oil from a common reservoir, and before being delivered, the oil is passed through a special cooler supplied by the customer. The oil circuit also includes a mechanical-type strainer and a magnetic filter. Pressure switches are incorporated to ensure that the table driving motor cannot be started unless there is sufficient pressure to relieve the table load, and should this pressure fall during operation, an audible warning is given.

A similar duplex pump arrangement, complete with strainer, filter, cooler, and separate reservoir, is provided for the lubrication of the main drive gearbox. The gearbox on top of the column, and the gears and bearings in the hob-slide, are lubricated by other independent systems. In addition, the various lubricating circuits have oil-flow-operated switches which are interlocked with the main driving motor. This arrangement ensures that the latter cannot be started unless the master worm drive, the main drive, and the gearbox on top of the column are being lubricated effectively.

Considerable attention has been paid to the provision for warnings should excessive temperatures be generated at various critical points of the machine, and automatic temperature-indicating equipment is installed. There are 12 thermocouples to determine the temperature in the lubricating and coolant systems, also of the air adjacent to the hob, and at the rear of the machine. The temperatures are indicated on a dial-type instrument, and a bell gives warning of an excessive rise at any monitored point. Duplicate pumps are fitted in the coolant system, one being held in reserve in the event of failure, and the coolant is drawn from a water-cooled reservoir below floor level at the rear of the machine.

DUAL MASTER WHEELS AND FEED SCREWS

As mentioned earlier, there are two master driving wheels beneath the work-table, each of approximately 114·6-in. pitch circle diameter. One of these wheels is of bronze, with 720 teeth of 0·50-in. pitch, and is reserved exclusively for finishing cuts. The other wheel, which is of cast iron, has teeth of considerably coarser pitch and is employed for all setting and roughing operations. Either drive may be engaged by means of a hand-operated selector. Both worms are of the dual-lead type, whereby backlash in the drive can be controlled by axial adjustment of the worm concerned, without disturbing the centre-distance between the worm and the wheel.

The fine-pitch (or finishing) worm has means for checking end-float and concentricity, also for conducting the conventional smoked-glass test for uniformity of worm rotation relative to table movement. A separate motor is provided for rapid rotation of the table, independently of the other machine movements.

Two vertical screws are provided in the throat of the column, for traversing the hob-slide, one of which is of fine pitch and high precision and is used for finishing cuts only. The other screw is of coarser pitch, and is employed for roughing cuts and adjusting purposes. A front view of the machine, without a workpiece in position on the table, is given in Fig. 2, where the two feed screws can be seen clearly, that at the left being the fine-pitch (finishing) screw. The plain shaft seen between the two vertical screws is used to transmit the drive to the hob spindle, through bevel gears and a worm and worm-wheel in the hob-slide. Provision is made in this drive for the addition, at a later date, of a "trailing" worm, which would mesh with this wormwheel to facilitate the elimination of backlash in the hob drive. An adjustment is provided to take up any end float in the hob spindle, and the bearing housings for the latter are arranged with a limited amount of tangential movement, for hob-setting purposes.

The hob-slide has a total of 5-ft. 2-in. vertical travel on the column, and is "over"-balanced so that climb-hobbing operations may be carried out.

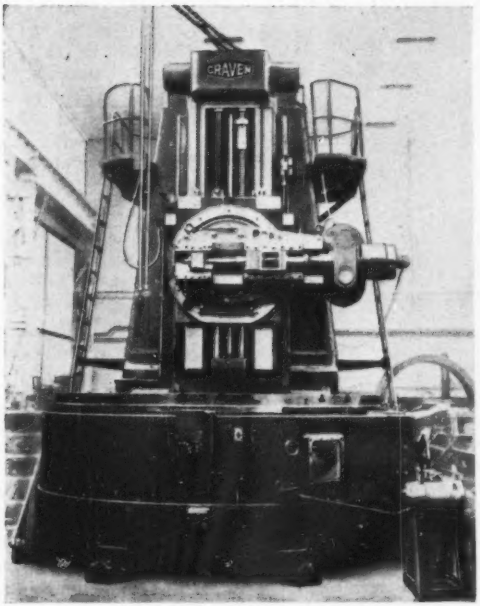


Fig. 2. A Front View of the Machine Shown in Fig. 1. Here can be seen the Two Vertical Screws for Elevating the Hob-slide

This slide can be swivelled through 180 deg., either by hand or power. When the hob spindle is being rotated at high speed, an electrically-driven fan is attached to the rear of the hob-slide to dissipate the heat which is generated by the final drive worm and worm-wheel.

As already mentioned, the machine is driven by a 30-h.p. electric motor, and provision is made for an alternative source of current supply. Switchgear has been installed by the customer so that an immediate change-over to this supply can be made should a current failure occur. Drive is transmitted from the main motor to the gearbox by multiple vee-belts, and care has been taken to isolate this box from the machine in order to minimize the transference of heat generated by the gearing. This gearbox houses all the principal driving mechanism, the spiralling and feed change gears, the dividing gears, and the prime number wheels, and hinged doors give access to the change gears.

LEVELLING ARRANGEMENTS

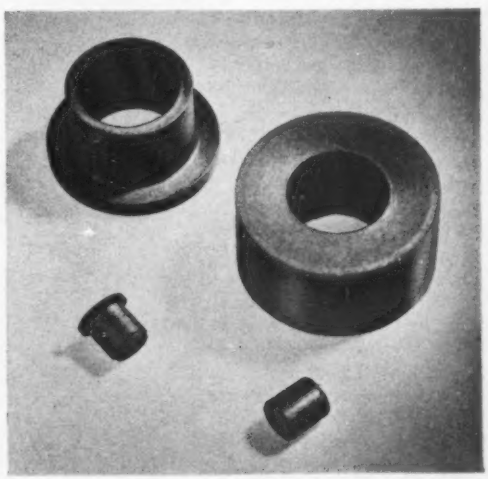
The machine is supported on a large number of screw-operated levelling wedges, some of which can be seen in Fig. 1. These wedges are interposed between the bed and a heavy fabricated-steel foundation frame, which is mounted on a 3-point suspension system on the floor of the foundation pit. Fixed levels are provided on the bed and the hob saddle for convenience when checking the alignment of the bed and column members.

An additional refinement is the provision of an adjustably-mounted alignment telescope and light source whereby the position of the lower journal bearing of the workpiece can be checked in relation to the centre line of the work-table.

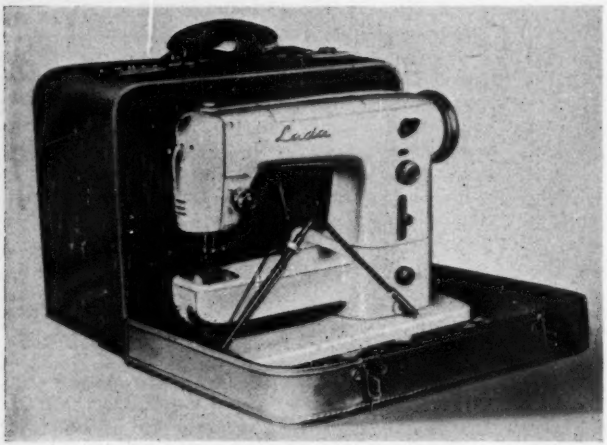
Chemloy "Dry" Bearing Material

A composite material known as Chemloy has been developed by the Crane Packing Co., Morton Grove, Illinois, U.S.A., for bearings intended for applications where the use of lubricants should be avoided. Some examples of bearings made from this material are shown in the accompanying illustration.

Bearings can be made from this material for both rotating and sliding parts which are to be operated at speeds up to 1,000 ft. per min., and they may be be run dry at temperatures up to 500 deg. F. The material is suitable for pressures up to 100 lb. per sq. in., and when it is used in contact with polished steel, the coefficient of friction is only 0·04. A high resistance to impact, also to the chemical action of solvents and most corrosive fluids is claimed for Chemloy.



Some Examples of "Dry" Bearings Made from Chemloy Material



Machining Castings for Lada Sewing Machines

Fig. 1. The Lada T-132 Portable Electrically-driven Sewing Machine Produced in Czechoslovokia

In MACHINERY, 93/77—9/7/58, reference was made to some of the activities of the TOS-Kurim Czechoslovak machine tool works, and in particular to the building of special-purpose machine tools incorporating unit heads of the cam, lead-screw, and hydraulic feed types. Whereas an appreciable proportion of the machine tools built at TOS-Kurim is destined for export, attention is also being paid to the modernization of Czechoslovak industry, and in the manufacture of sewing machines at the Lada works, Sobeslav, for example, unit head machine tools are extensively employed for operations on light-alloy and iron castings.

The Lada works, established some 40 years ago, now provide employment for approximately 1,000 people, and sewing machines are being produced at the rate of 50,000 per year, many of which are exported. Both portable and standard types of machines are made, the latter comprising about 60 per cent of the output. Known as the Lada T-132, the portable machine is shown in Fig. 1. It is electrically driven, and in its construction extensive use is made of light-alloy pressure die castings, produced on Czechoslovak-built Polak machines at another factory. The standard machine, known as the Lada 236, is of an improved design, only recently introduced, and the iron castings employed are made in a foundry at the Sobeslav works.

Machine base and head castings for the 236 machine are shown in Fig. 2. The preliminary operations on the head casting, comprising milling the top and bottom faces, the side faces, the front end face, and the long, stepped portion of the top face, are carried out with the work clamped in hand-operated fixtures on standard horizontal and vertical, and duplex horizontal, milling machines. Fig. 3 shows the set-up, on a duplex machine, for milling the side faces, using tungsten carbide inserted-tooth cutters. Here, the work is located by the previously-machined stepped bottom face,

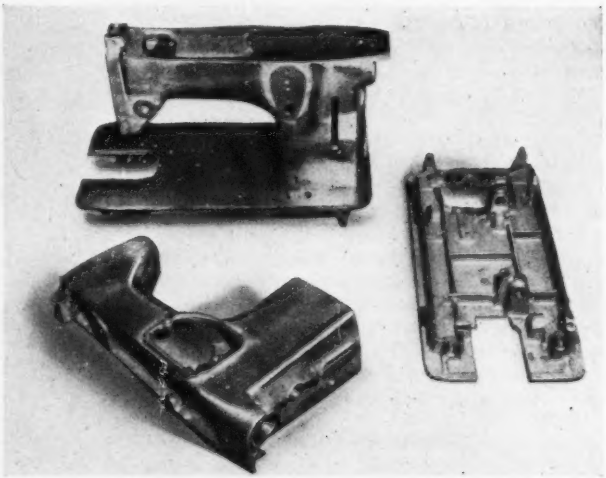


Fig. 2. Machined Cast-iron Base and Head Components for the Lada Type 236 Standard Sewing Machine

and is held by a cam clamp applied to the top face. A similar duplex machine is employed for milling the top faces of the base casting, two at a time. One operator tends two, and sometimes three, machines.

As seen in Fig. 4, a horizontal, 3-way machine, equipped with unit heads incorporating spindle quills, which are traversed by internal lead screws, is employed at a later stage for drilling, spot facing, and reaming holes lengthwise and transversely through the bosses on the underside of the base casting. The workpiece is held, machine face downwards, by a swing-over rocker clamp.

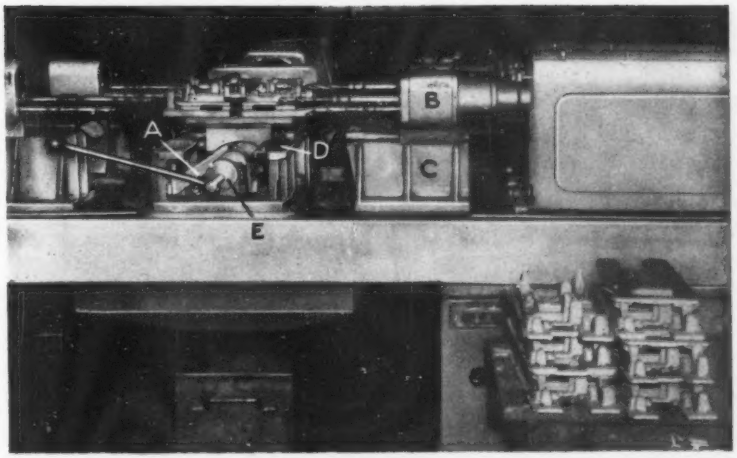


Fig. 4. Horizontal 3-way Machine, Incorporating Unit Heads, for Drilling, Reaming and Spot-facing the Base Casting

Two unit heads, arranged side by side, are provided on both the right and left of the fixture, and the latter is mounted on a trolley fitted with flanged wheels, which can be moved transversely by hand along the rails *A*. Operations are first performed by the front right- and left-hand heads, and upon completion of this part of the cycle, the fixture is moved to the rear, and further operations are carried out by the duplex heads immediately behind, also by the transverse head at the rear. It will be noted that support for the relatively heavy spindle heads *B*, on the quills, is provided by slide bases, as at *C*. In the two working positions, the fixture trolley is lifted clear of the rails *A*, and clamped against the under-faces of the location blocks *D*, by means of cams, as at *E*, on a transverse shaft which is rotated by a long hand lever. During the upward movement, dowel pins on the fixture engage bushes in the blocks *D* for location purposes. With this arrangement, the presence of swarf between the clamping faces is avoided.

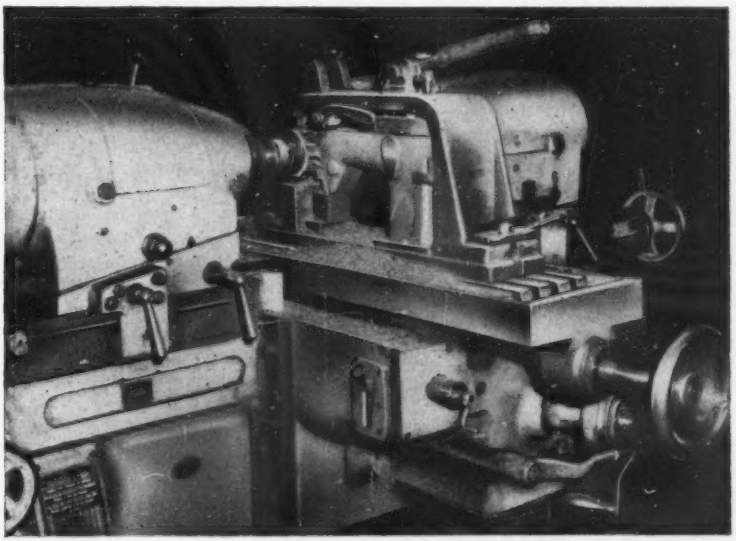


Fig. 3. Set-up on a Duplex Horizontal Machine for Milling the Side Faces of the Head Casting

A duplex horizontal machine, equipped with unit heads of a similar design, is used at a previous operation for drilling and reaming transverse bosses. On this

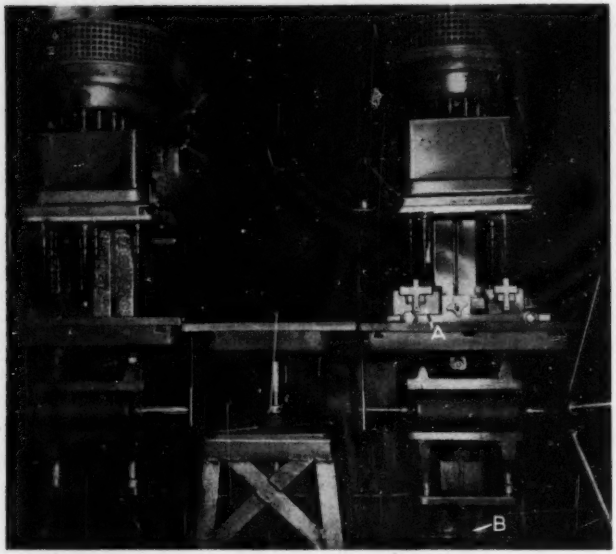


Fig. 5. Arrangement of Two Boley Multi-spindle Machines for Drilling the Smaller Holes in the Base Casting

machine, the fixture is moved vertically, when the drilling stage has been completed, to align the work with the reaming spindles, after pivoted drill bush plates have been swung clear.

Reference may also be made to an installation comprising two Boley multi-spindle machines, seen in Fig. 5, for drilling certain of the smaller holes in the cast-iron base plate. On the left-hand machine, 10 holes are drilled, and on the right-hand machine, seven holes, and the two are linked by a table unit, provided with screw adjustment for height, which enables the roller-mounted jig *A* to be readily moved along rails from one to the other. Loading and unloading of the castings is conveniently carried out with the jig on the centre table, and end stops are fitted on each machine table. Because of the size of the drill jig, the relatively small standard table and bracket assembly on each machine has been replaced by a unit of more robust design, incorporating two round guide pillars for the table. The latter is raised and lowered by hand lever, through rack and pinion, a counterbalance spring being provided at *B*.

A duplex horizontal machine, incorporating a fixture which is indexed vertically, by hand-wheel, to two working positions, is installed for drilling the head casting, and there is also a 3-way machine, in which the fixture is indexed to the rear for semi-finish machining the two shaft bores after the holes have been drilled at the front station. These two holes, for the drive shafts, are finish bored with single-point tools in the duplex machine seen in Fig. 6, after the casting has been spray painted and stoved, to obviate any slight inaccuracies from heat distortion. This machine is installed in an annex of the main assembly shop.

Fig. 7 shows a special-purpose machine incorporating two right-hand and two left-hand unit

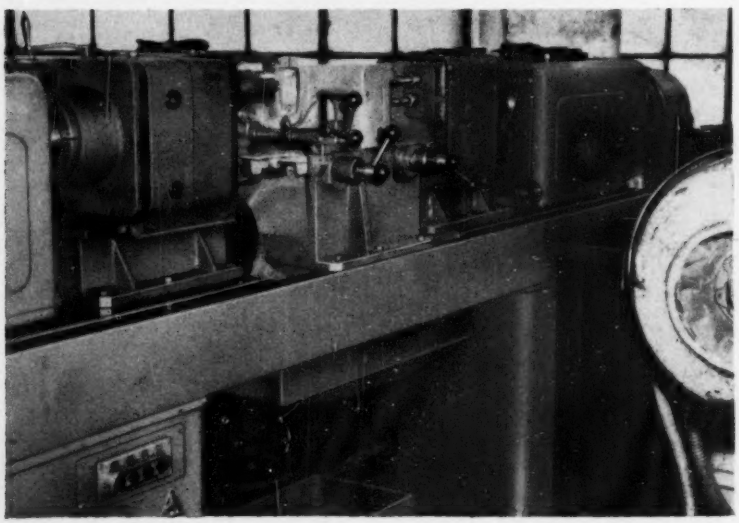


Fig. 6. Duplex Machine for Finishing the Main Shaft Bores in the Head After it has been Spray Painted and Stoved

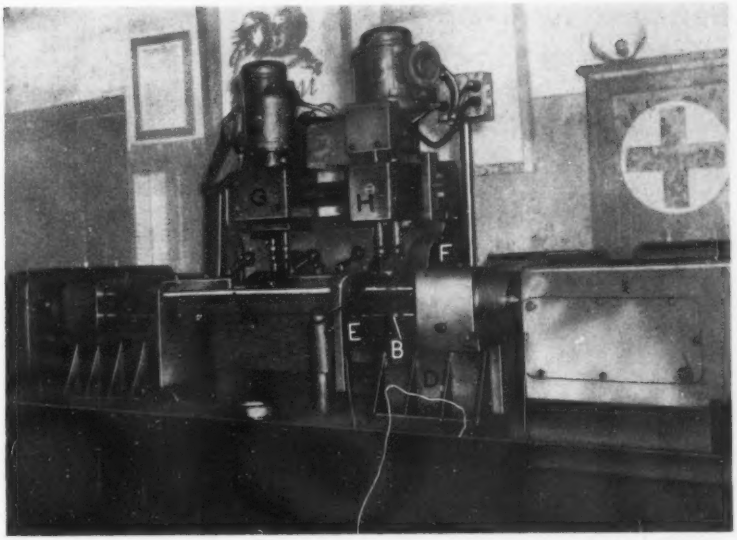


Fig. 7. Special-purpose Machine with Automatic Rising and Falling Fixture for Drilling and Tapping Holes in a Treadle Frame Casting

heads of the traversing quill type, and three specially-designed vertical heads, each fitted with a drilling spindle and a tapping spindle, for drilling, facing and tapping holes in eight bosses of the main cast-iron frame member for a sewing machine treadle mechanism. The casting, one edge of which may be seen at *A*, is held horizontally on seatings in the fixture by means of four hand-operated clamps. After the horizontal holes have been drilled, by a lower spindle, as at *B*, in each head, the fixture is automatically raised to the position shown, so that the boss faces can be machined by cutters in the upper spindles *C*. The spindle housings attached to the quills of the unit heads are supported on slide bases *D*, which carry bush plates *E* at the front, to guide the tools.

The vertical heads are arranged to move horizontally along a cross rail carried on columns *F*, two of the heads being mounted on the front of the rail, as seen at *G* and *H*, and the third head, at the rear. These heads come into operation automatically when the work is in the raised position. After the three holes have been drilled, the heads are traversed by screw along the cross-rail to bring the tapping spindles into the working position. The operator is only required to load and unload the work, and the floor-to-floor time is 2½ min.

As already mentioned, the light-alloy pressure die castings for the Lada T-132 portable sewing machine are produced at another factory, where preliminary face milling operations are performed on the head and base members, and the two cast-

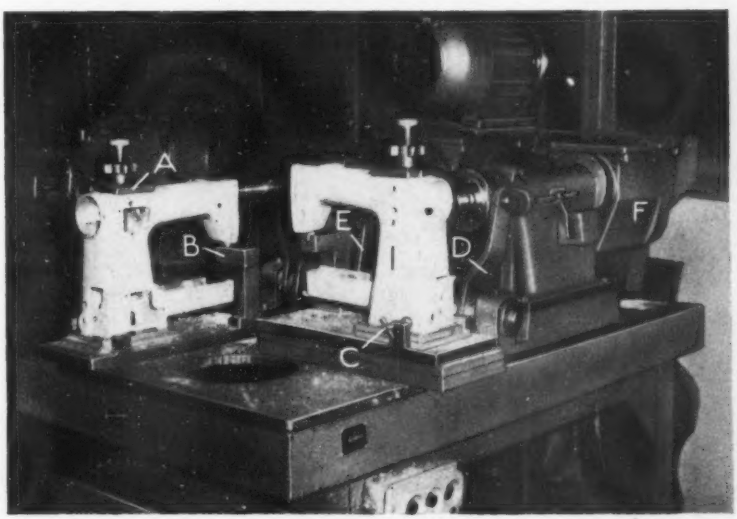


Fig. 8. Two-station Machine for Carrying Out Two Different Boring Operations on the Light-alloy Die-cast Head of the Lada T-132 Portable Sewing Machine

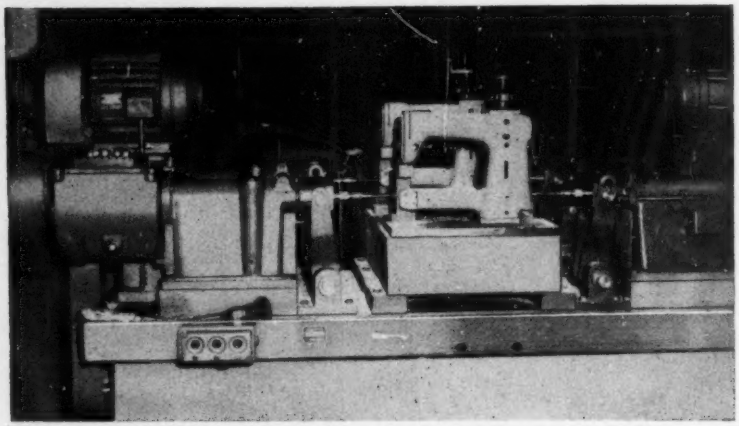


Fig. 9. Horizontal, Duplex Machine for Drilling the Die-cast Head

ings are supplied to the Lada works as an assembly, secured together by screws and dowels. These assemblies may be seen in Fig. 8, where two different boring operations are being performed on a 2-station machine, equipped with unit heads developed at the Lada factory. The workpiece is held on the fixture base by a through bolt and top clamp plate *A*, and a support *B* is provided for the overhung end of the head. A screw *C* clamps the casting against a side location block. A fixture of similar design is employed, at a later stage, on the horizontal 2-station machine, seen in Fig. 9, which is equipped with two right-hand and two left-hand spindle heads of the type employed for the machine in Fig. 8.

With this design of head, the rapid approach, feed, and quick return motions of the spindle quill are effected by a yoke lever *D*, Fig. 8, mounted on a cross shaft which also carries an arm *E*. The latter is coupled to a rod fitted, at the opposite end, with a roller which engages a cam mounted on a cross shaft in the gearbox unit *F*. One electric motor drives two spindle heads. A duplex, horizontal machine, incorporating unit multi-spindle heads of the type fitted to the machine seen in Fig. 7, is installed for carrying out certain drilling operations on these light-alloy die castings. One operator tends two or more machines.

DUPLICATE ASSEMBLY LINES

The arrangement of the assembly line for the Lada-236 sewing machine presents features of interest. This line is shown in Fig. 10, and a close-up view of one of the working stations is given in Fig. 11. The various stages of assembly are carried out with the sewing machine held by the head casting in a universal, swivelling fixture mounted on a cast-iron base *A*, which is provided with rollers and is moved by hand from one station to the next along a fabricated steel track. Two radiused rollers, mounted on vertical studs in the base, run in the upper inverted channel member *B*, and the weight of the unit is taken on two lower rollers, as at *C*, which have rear flanges.

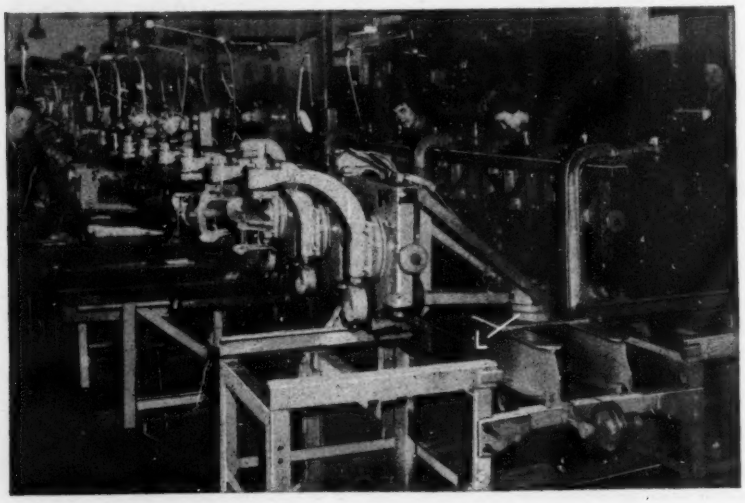


Fig. 10. General View of the Two Assembly Lines for the Lada-236 Standard Sewing Machine

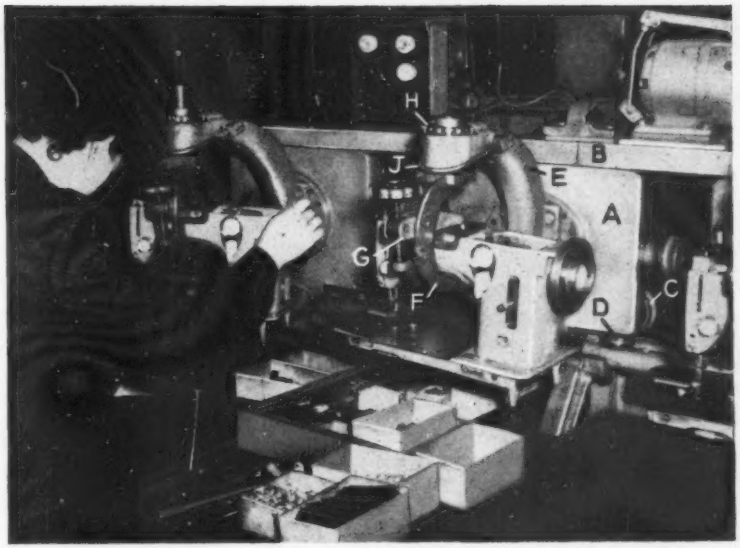
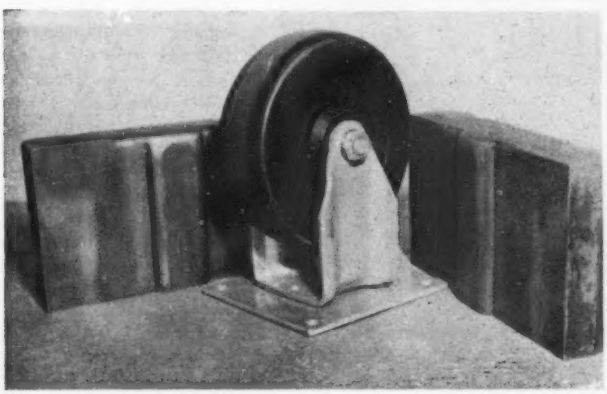


Fig. 11. View of a Working Station on One of the Assembly Lines

Lateral location in the opposite direction is provided by two radiused rollers, one of which is seen at *D*, mounted on vertical studs.

At each working station, the fixture unit is located by a spring-loaded detent, which is released by depressing a pedal. Another spring-loaded detent, disengaged by means of a second pedal, enables the fixture arm *E*, Fig 11, to be indexed to various angular positions about a horizontal axis on the base. The work is held between soft pads in a C-shaped member *F*, by means of a screw-operated clamp *G*, and the member *F* can be turned about a vertical axis to various working positions. The latter are determined by an index plate *H*, in conjunction with a spring-loaded plunger which is disengaged by the stirrup lever *J*. Provision is made at various points on the line for driving the sewing machine by belt, for testing and running-in purposes.

There are two assembly lines arranged back to back, and Fig. 10 is a view from the finishing end of the line on the left. After the completed sewing machine has been removed from the fixture trolley, the latter is traversed forward, as seen at *K*, on to an extension of the rails which is pivoted at *L*. This rail extension is then swung by hand through 180 deg., so that the empty fixture is aligned with the rails at the starting end of the duplicate assembly line on the right. A similar transfer arrangement is provided at the opposite end of the lines, from each of which an output of 12 sewing machines per hour is obtained. Originally, it may be noted, only the left-hand line was installed, and the trolley fixtures were returned to the starting end by a wire cable system at the rear.



The Flame-Plating process is employed to increase the life of dies used to shape the side plates of castor brackets at the works of the Bassick Co., Bridgeport, Conn., U.S.A. This treatment also enables a better product to be obtained by eliminating scoring of the bracket blanks by the dies. It is stated that more than 15,000 unscored brackets have been produced with treated dies. Developed by the Linde Co., a Division of Union Carbide Corporation, U.S.A., Flame-Plating involves the deposition of a thin coating of tungsten-carbide or aluminium oxide on a metal surface by means of controlled detonation

Advantages of Synthetic Industrial Diamonds for Grinding Wheels

By N. A. MATTHEWS* and NORMAN LEVENTHAL*

The discovery of a reproducible process for making industrial diamonds was announced in February, 1955, by the Research Laboratory of The General Electric Co., U.S.A. The responsibility for developing a commercial process to produce the diamonds was assigned to the Metallurgical Products Department of the company at Detroit, Mich. When it was shown that the inherent capabilities were such that the product could be competitive in respect of cost, it was necessary to obtain information concerning the properties of the synthetic stones, as compared with those of natural diamonds.

To this end, a comprehensive programme was arranged to determine the relative grinding efficiency of natural and synthetic diamonds. A series of laboratory and production applications was chosen to obtain comparisons over a wide range of common tungsten-carbide grinding applications. Some of these applications involved fixed-feed surface grinding, tool and cutter grinding, and single-point tool grinding. From these tests, it was found that synthetic diamonds are superior to natural stones in resin- and vitreous-bonded wheels for grinding cemented tungsten carbide. This superiority averaged 35 per cent, and in some production-grinding tests the performance of synthetic diamond was 100 per cent better than that of the natural material.

* Metallurgical Products Department, General Electric Co., U.S.A.

PREPARATION OF TEST WHEELS

In view of the number of variables involved in making up test wheels—including bond batch, pressing temperature, and curing cycle and temperature—it was important that all controllable factors should be kept constant. The only variable would be diamond.

Companion wheels were made up by the grinding wheel manufacturers, using closely-sized natural and synthetic diamonds, with the normal production equipment. The companion wheels incorporated resin- or vitreous-type bond of the same batch and were processed through curing cycles at the same time. Normal sizing techniques were applied to both types of diamonds, so that the average particle size and distribution were the same for each comparison set of wheels. Test results are reported only for applications where quantitative comparison data were obtainable, and are expressed as the ratios of cubic inches of carbide ground per cubic inch of wheel wear. A group of various sizes and shapes of wheels made from synthetic diamonds and employed in the comparison tests described in this article is shown in Fig. 1.

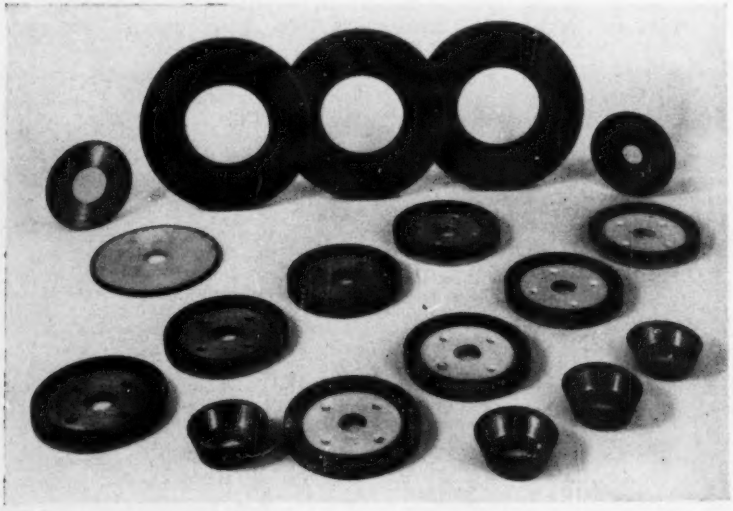


Fig. 1. Examples of Straight, Plain-cup and Flared-cup Grinding Wheels Made from Synthetic Diamonds for Use in Comparison Tests

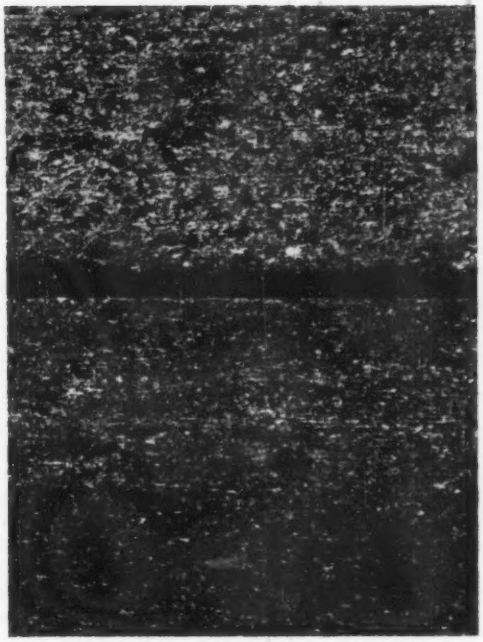


Fig. 2. Views of Worn Diamond Grinding-wheel Surfaces of Identical Specifications. The Natural-diamond Wheel at the Top Shows More Pockets than the Synthetic Diamond Wheel Because the Crystals of the Latter are More Firmly Held in the Bond

METHOD OF LABORATORY TESTING

The first step in wheel performance testing was carried out in the laboratory of the Metallurgical Products Department's Diamond Section. Operations were performed on a Brown & Sharpe No. 2 surface grinder, with a spindle speed of 5,000 r.p.m., a table traverse of 372 in. per min., and a cross-feed of 0·050 in. per table pass in both directions. Total vertical down feed per run was 0·200 in. and the vertical feed for each completed cross-feed in both directions was 0·001 in. The carbide work surface ground was 2 in. wide by 12 in. long, and the material was Carboloy cemented carbide Grade 883 (a tungsten carbide with 6 per cent cobalt binder). Grinding was performed wet with soluble oil and water in a ratio of 1 to 400.

The wheels were mounted on precision, tapered-hole collets to run true radially within 0·001 in. and laterally within 0·002 in. A Norton brake-controlled truing device was used for the set-up. Results recorded included wheel wear obtained by averaging micrometer readings to the nearest 0·0001 in. on three marked diameters. Material removed was also measured to the nearest 0·0001 in. Power measurements and Profilometer readings were compared in all cases.

Laboratory results indicated that the performance of the wheels made with synthetic diamonds was superior, in varying degrees, in terms of the ratio of cubic inches of carbide removed per cubic inch of wheel wear. With equal down feeds on the surface grinder, the wheels containing synthetic diamonds removed an average of 2 per cent more carbide, and the wheel wear was significantly lower.

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After the laboratory tests, wheels were made up for evaluation on production grinding machines. In every instance, the operator was unaware which wheel contained synthetic diamonds. Wherever possible, the types of carbide ground, as well as the sizes of the work surfaces, were the same for each set of companion wheels, to avoid introducing factors that might influence the final results.

One phase of the testing programme was carried out in the General Electric Co.'s Metallurgical Products Plant in Edmore, Mich., where thousands of single-point tools are ground daily during a single shift. Some of the carbide tools ground in various tests are seen in Fig. 3. For these tests, the wheels—one with natural diamonds and the other with synthetic diamonds—were mounted on two automatic, two-station tool-grinders, side by side. These tool-grinding machines, one of which is shown in Fig. 4, were developed during the second world war by the Hotpoint Co., Chicago, Ill.

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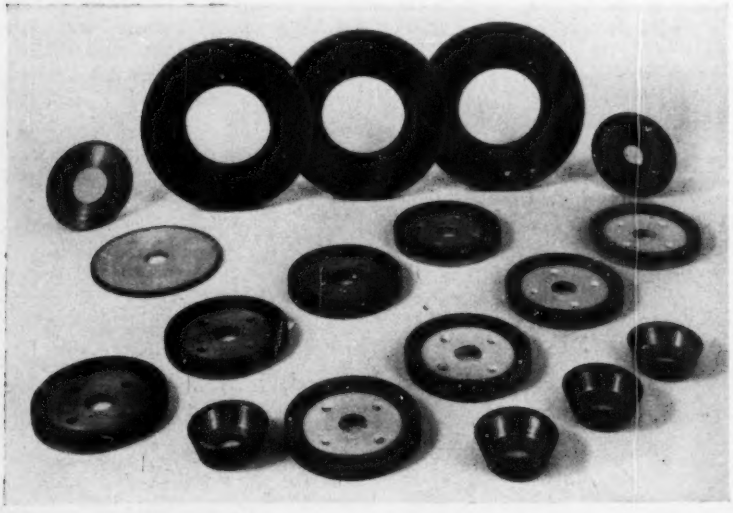

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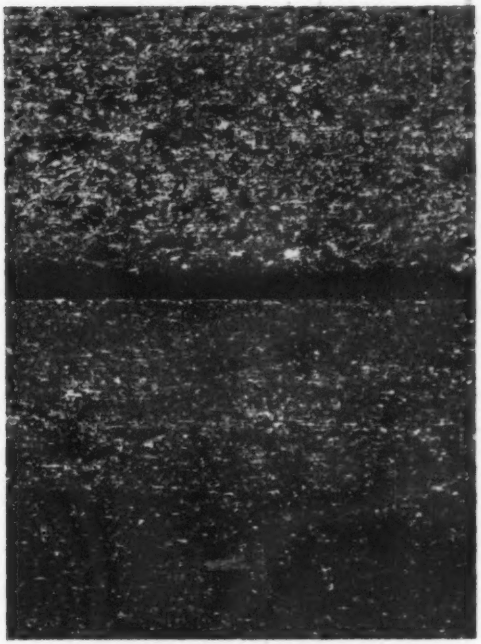

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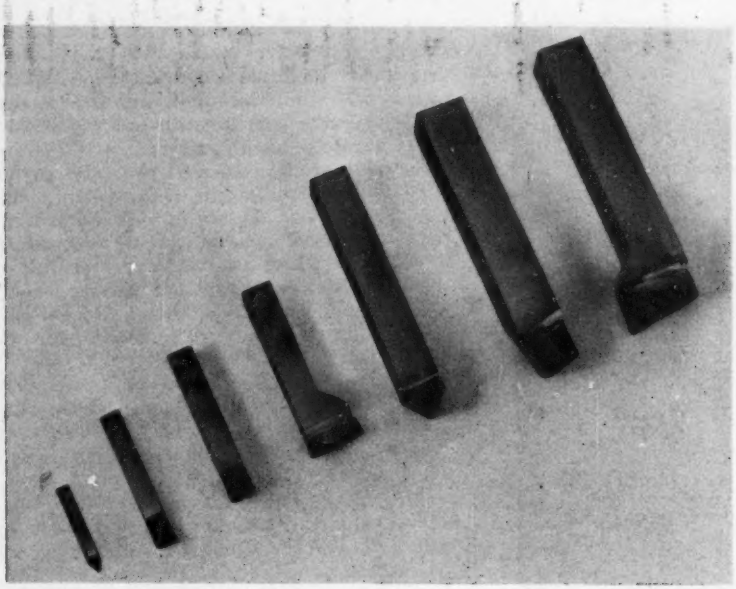


Fig. 3. Examples of Carboloy Cemented-carbide Tools which were Ground in Comparison Tests to Determine the Relative Efficiencies of Synthetic Diamond and Natural-diamond Grinding Wheels

Orders for tools of specific types were split so that the same number of tools of a certain size and specification was ground on each wheel. In an effort to reduce operator and machine effects on the test results, the wheels were transferred between the grinding machines every other day.

Fig. 4. Automatic 2-station Tool-grinder Employed in Testing Diamond Wheels. A Wheel with Natural Diamonds was Used at One Station, and a Wheel with Synthetic Diamonds at the Other

Detailed results of carbide loss and wheel wear were obtained until the wheels were completely used.

Wheels chosen for the production tests on the Hotpoint grinders were of the standard vitrified-bond, plain-cup type of 6 in. diameter by ¾ in. thick, with a ½-in. rim. Such a wheel is shown in Fig. 5. The specification called for 129-grit diamond of 100 concentration, with a ⅛-in. diamond depth on the wheel face. In a typical test, one of these wheels containing synthetic diamond removed 45 per cent more carbide. This particular wheel ground 19,374 tools, compared with 13,715 tools for the companion, natural-diamond wheel.

In one of the production comparative tests on Thompson surface grinding machines in the General Electric Detroit Plant, two vitrified-bond straight wheels (of 10 in. diameter by ¾ in. wide) of 100 grit and 100 concentration were evaluated. The synthetic diamond wheel gave a 24 per cent better performance in this test, which involved the grinding of a wide variety of shapes and grades of Carboloy cemented carbide.

During a recent test, a pair of metal-bonded cup-shaped wheels was tested on an electrolytic grinder at General Electric's Edmore plant. These straight-cup wheels were of 6 in. diameter with ¾-in. wide rim, 120 grit, 100 concentration, and $\frac{1}{16}$-in. diamond depth. In this test, the synthetic diamond wheel gave a 33 per cent better performance than the natural-diamond wheel, in terms of cubic inches of carbide ground to cubic inches of

SUMMARY OF WHEEL TESTS

Test No.	Grinding Machine	Wheel Type	Wheel Size, in.	Wheel Specification	Efficiency Ratios: Cu. In. of Carbide Removed per Cu. In. of Wheel Wear		
					Natural Diamond	Synthetic Diamond	Relative Grinding Efficiency*
1	Brown & Sharpe No. 2 Surface Grinder	DIT Straight	7 × ¼ × ¼	D100L100V-1/8	121·7	162·7	133
2	Thompson	DIT Straight	10 × ¼ × 5	D100L100V-1/8	12·8	15·9	124
3	Brown & Sharpe No. 2 Surface Grinder	DIT Straight	5 × 7/64 × 1¼	D220N100B-1/8	113·8	136·4	120
4	Cincinnati No. 2 Tool and Cutter	D11B Flared Cup	3¼ × 1¼ × 1¼	D150N100B-7	10·5	15·0	143
5	Hotpoint	D6WHC Cup	6 × ¼ × 1¼	D120T100V-1/8	29·0	42·0	145
6	Hotpoint	D6WHC Cup	6 × ¼ × 1¼	D120T100V-1/8	16·9	30·6	181
7	Hotpoint	D6WHC Cup	6 × ¼ × 1¼	D120T100V-1/8	21·2	42·9	202
8	Hotpoint Electrolytic	D6WHC Cup	6 × ¼ × 1¼	D120N100M-1/16	23·3	31·1	133

* Ratio of performance of synthetic diamond wheel to natural diamond wheel multiplied by 100.

Note.—While the comparisons between the efficiency ratios of the straight 7- × ¼-in. and 5- × 7/64-in. wheels are valid, the efficiency ratios were noticeably higher than are usually found in production grinding. These wheels were tested in the laboratory under closely controlled conditions. The wheels were not dressed after the test had begun, and there was not the intermittent contact between the wheel and the carbide normally experienced in production. A relatively large piece (12 × 2 in.) of Grade 883 Carboloy was ground.

wheel wear. With this type of grinding, although a metal bond is used, unit pressures between the work and wheel are relatively low.

When the results of 25 closely controlled tests, involving both production and laboratory grinding, were summarized, it was concluded that synthetic industrial diamonds in resinoid- and vitrified-bonded wheels, when used for grinding carbide, out-performed natural diamonds by an average of 35 per cent. Results of some of the tests are given in the accompanying table.

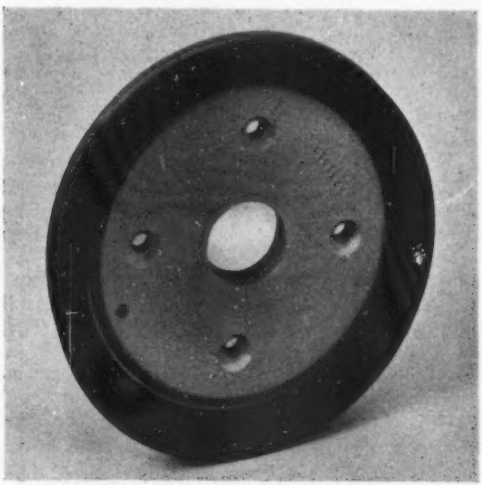


Fig. 5. Vitrified-bond, Plain-cup Grinding Wheel Made with Synthetic Diamonds of 120 Grit. The Wheel is 6 in. Diameter by ¾ in. Thick, and has a ⅛-in. Diamond Depth of 100 Concentration

WHY SHOULD SYNTHETIC INDUSTRIAL DIAMONDS PERFORM BETTER?

Crystallographically, both synthetic diamonds and natural diamonds are identical. Both give strong X-ray patterns that are indistinguishable from each other. Physically, however—and particularly as regards crystal habit—there is a difference which may be readily detected under a microscope. The synthetic diamonds are generally blocky, rough-surfaced crystals, with a small percentage of intergrown, dendritic, and skeletal type crystals. The natural bort, on the other hand, varies widely in particle form from flat to blocky shapes, with some elongated pieces, and the surfaces are generally smooth. A comparison is shown in Fig. 6.

Since the synthetic diamonds have rough jagged surfaces, there is better mechanical support of the crystals in the bond which results in less diamond loss while grinding. Another factor contributing to the superiority of synthetic diamonds is that they are more friable. They therefore tend to fracture more readily and present new, sharp cutting edges. As a result, a freer cutting action is obtained, power requirements are lower, and carbide removal is greater.

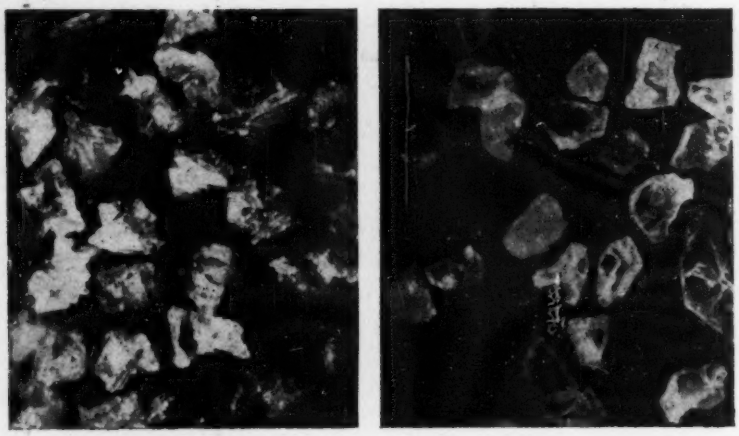


Fig. 6. Crystals of Natural Diamond (left) Vary Widely in Shape and are Generally Smooth Surfaced. Synthetic Crystals (right) are Usually Blocky and Rough Surfaced. The Crystals are 80 to 100 Mesh, and are Shown at About 40× Magnification

If the diamonds wear more rapidly, it may be asked, why do the wheels give longer life? The answer is that the mechanical bond is better. Synthetic diamond crystals are held in the bond until they are more completely used. On the other hand, there is a tendency for a natural diamond to be pulled out when more than half of a particle protrudes through the bond surface. Another factor is the absence of splinters and flats in synthetic diamond. These shapes are inherently weaker than blocky crystals, and do very little actual metal removal before they break off.

CURRENT LIMITATIONS OF SYNTHETIC DIAMONDS

At present, synthetic diamonds are limited to applications involving 80-mesh crystals (177 microns) and smaller. Superiority of such diamonds is most pronounced in resinoid- and vitrified-bond wheels. The extremely high feed rates and high unit pressures involved in cutting-off applications produce a degree of stress on the diamond crystals which the friable synthetic crystals at present available cannot withstand. Several comparative trials with resinoid- and metal-bonded cutting-off discs, made from diamond particles of 60 to 220 mesh, showed inferior results to those obtained with natural diamond when operating on glass, cemented carbide, tile, and granite. Similarly, the results with metal-bonded wheel applications generally have not been comparable to those achieved with natural diamonds except in the case of electrolytically assisted grinding of tungsten carbide, as previously mentioned.

Thus, the major development problem in providing for a broader field of application for synthetic diamond is to produce somewhat stronger and coarser crystals over the range from 20 to 80 mesh.

In addition, stronger and more consolidated crystals are needed to operate satisfactorily in metal-bonded wheels and cutting-off discs, in a full commercial range of sizes.

Synthetic diamonds are now available to grinding-wheel manufacturers in the U.S.A. and any wheel user can order wheels with such diamonds.

At the time that pilot-plant production of synthetic diamonds was announced on October 22, 1957, the price was 4·25 dollars, per carat. Today, the price is 3·48 dollars, and it is hoped that further reductions will be possible to make them more competitive with natural industrial diamonds, which at present are being marketed at approximately 2·80 dollars per carat.

DEVCON EMERGENCY REPAIR KIT. An emergency repair kit for sealing leaks in pumps, pipes, valves, and tanks, for instance, while the equipment concerned is in working service, has been added to the range of Devcon products which are marketed by E. P. Barrus (Concessionaires), Ltd., 12/16 Brunel Road, Acton, W.3. The kit comprises a 1-lb. tin of Devcon plastic steel, hardening agent, a section of rubber-lined steel, and a supply of specially-treated laminated glass tape.

Devcon plastic steel consists of 80 per cent steel and 20 per cent plastics material, and can also be used for securing bolts or machinery in concrete, and repairing stripped threads, for example. When Devcon is spread on the laminated glass tape and applied to a leak or hole, compressive and tensile strengths of the order of 50,000 and 45,000 lb. per sq. in., respectively, are obtained.

Installation for the Production of Alloys of High Purity

Among the alloys now being produced by the Metals Division of The Telegraph Construction & Maintenance Co., Ltd., Crawley, Sussex, are Rhometal, Radiometal, H.C.R. alloy, Mumetal and Supermumetal, all of which are nickel-iron compositions, and are now being used extensively for cores and laminations for servo-mechanism and other devices incorporated in guided missiles, machine tool control apparatus, and equipment for automation. Another range of alloys contains cobalt, vanadium, and iron in varying proportions, and, under the trade names Supermendur and Permendur, these alloys are supplied to manufacturers of electrical equipment whose products include lightweight generators for aircraft, telephone diaphragms, and magneto-strictive devices. The company is also engaged in the production of heat-resistant alloys of the types from which gas turbine blades are made.

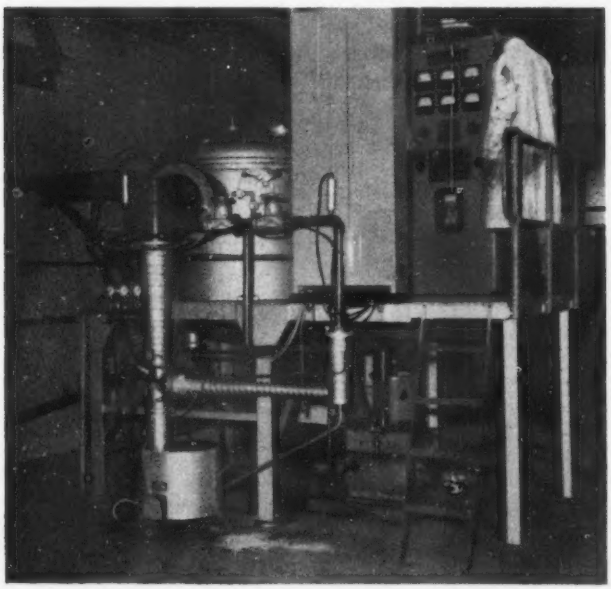


Fig. 1. Efco-Edwards 56-lb. Capacity Vacuum Melting and Casting Furnace, Installed at the Works of the Telegraph Construction & Maintenance Co., Ltd.

The plant installed for the production of the various alloys to high standards of purity includes vacuum melting furnaces, two examples of which are shown in the accompanying illustrations. In Fig. 1 is seen an Efco-Edwards 56-lb. capacity vacuum melting and casting furnace and associated equipment. Alloying elements are melted and poured, in vacuo, at temperatures up to 1,800 deg. C., in the cylindrical chamber which may be seen on the left of the staging. A Kinney vacuum pump located under the platform, and an Edwards diffusion pump mounted against the framework of the staging, serve to evacuate air from the vacuum chamber and to remove condensable vapours during melting and casting. When working on maximum load, the complete installation requires an input of approximately 64 kW., most of which is consumed by the induction heating equipment. A larger vacuum melting and casting furnace, of 5 cwt. capacity, is shown in Fig. 2. Specially made for the Telegraph Construction & Maintenance Co., Ltd., this furnace is of sufficient size to accept the ingot mould shown on the left of the illustration, through a circular opening in the wall of the vacuum chamber. The mould lies in a horizontal position inside the chamber while the charge, in an adjacent crucible, is being melted, and during this stage of the cycle the process is observed through windows set in the domed cover of the chamber. When melted, the charge is transferred from the crucible to the ingot mould by a pouring movement, which takes place automatically when the chamber is tilted forward on its trunnion mountings through 90 deg. A motor-generator set, which has an output of 150 kVA., at 500 cycles per sec., and a Kinney vaccum pump of large capacity, form part of this installation.

After being stripped from the moulds in which they are cast in this furnace, the ingots are converted into billets and slabs, by hot working, before they are cold rolled into sheet

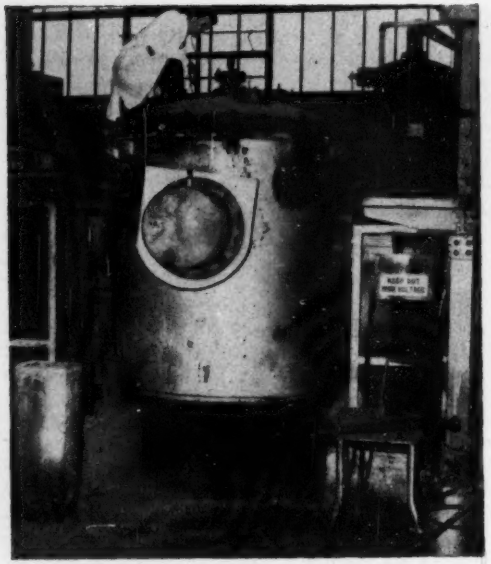


Fig. 2. Specially-constructed 5-cwt. Capacity Vacuum Melting and Casting Furnace, which is Arranged to Pour into an Ingot Mould

or drawn into rod or wire. For certain applications, Mumetal and other alloys are required by manufacturers in the form of very thin strip, ⅛ in. or ¼ in. wide by 0·001 in., 0·0005 in., or 0·00025 in. thick, wound on ceramic bobbins or enclosed in nylon or Bakelite cases. This thin material is produced by re-rolling strip between two miniature rolls, of approximately ⅜ in. dia., supported in a fixture and positioned between, and in contact with, the surface of, two opposed rolls of much larger diameter. The latter form part of a standard rolling mill and, in this instance, serve only as a means of applying pressure and rotary motion to the miniature work rolls. In Fig .3, the arrangement is shown diagrammatically and it will be noted that the miniature rolls are automatically located against their bearing pads *A* by pressure exerted by the main rolls. The thin rolled strip is indicated at *B*.

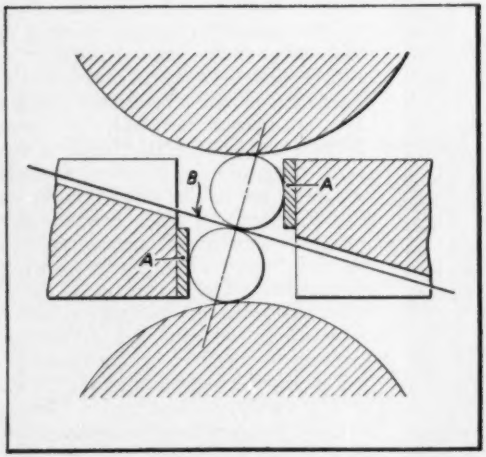


Fig. 3. Diagram Showing the Auxiliary Rolls which are Used in Conjunction with a Conventional Rolling Mill for the Production of Very Thin Mumetal Strip

Another department of the factory specializes in the production of beryllium-copper alloys, which are widely used for fuse clips, electrical spring contacts, mould inserts—especially when hobbing techniques can be employed—and non-sparking tools. The section in which these alloys are cast, and in some instances fully machined, is of recent construction and extends to approximately 7,000 sq. ft.

CUTTER FOR PLASTICS SHEET. Tubela Engineering Co., Ltd., Fowler Road, Hainault, Ilford, Essex, have introduced a hand tool for cutting laminated plastics sheet and similar material. Of cranked form, the tool operates with a shearing action and removes a narrow strip of material. It has no knife edge and does not require sharpening. Sheet of any width can be cut, and the shearing blade is of radiused form to provide for "lead-out" of the waste strip. Owing to the controlled blade clearance, it is stated, clean cuts are obtained.

LANSING BAGNALL SAFE LOAD INDICATOR. For application to any tilting-mast type fork-lift truck in their range, Lansing Bagnall, Ltd., Kingsclere Road, Basingstoke, Hants, have developed and patented a hydraulically-operated capacity indicator. For this purpose, the normal rigid mounting between the moving end of the tilting jack and the mast structure has been abandoned. There is now a point of leverage on each mast frame member, and this pair of points is connected to a central position, where an oil-filled metal bellows measures the sum of the forces to which the jacks are subjected.

Resulting movement of the bellows is transferred hydraulically to a large-diameter dial with segments which indicate the "safe," "operate with care," and "danger" ranges.

News of the Industry

Huddersfield

DAVID BROWN INDUSTRIES, LTD., Keighley Gear Division, Lockwood, are well employed on the cutting of spur, bevel, worm and double-helical gears of various sizes. Orders are in hand from makers of cranes, hoists and mining conveyors, also for power station applications. Stock spur gears are in steady demand.

PLANERS (HUDDERSFIELD), LTD., Lockwood, have orders in hand for double-housing planing machines, ranging from 3 to 8 ft. wide and for planing up to 30 ft. long, also for openside-type machines up to 20- by 5-ft. square capacity. We hope shortly to make further reference to two recently completed machines, comprising a double-standard type, of 16- by 6-ft. square capacity, with four tool-boxes and an independent motor-driven milling head, and an openside type, of 8- by 4-ft. square capacity, provided with hydraulic copying equipment. The latest addition to the plant is a Mannesmann rack cutting machine.

WILLIAM WHITELEY & SONS, LTD., Lockwood, report a steadily-maintained demand for their dished and plate-type handwheels, ranging from 4 to 16 in. diameter, and for various types of ball and knob handles and grips for use in the general engineering and machine tool industries.

HOPKINSONS, LTD., Britannia Works, are busy with home and export orders for various types of valves and boiler mountings. Recent extensions, equipped with additional machine tools, are now in production on atomic power station valves and forged steel valves. It is reported that the firm's oil purifying equipment is in steady demand. A range of the company's manufactures can be seen at the Brussels World Fair, and valves and boiler mountings will also be on view at the Industrial Fuel Efficiency Exhibition to be held at Olympia, London, from September 24 to October 3.

HIGHFIELD GEAR & ENGINEERING CO., LTD., Nile Street, have good orders for all types of gear-cutting, covering spur, bevel, double-helical, spiral and worm gears of various sizes, also for standard spur, bevel and worm reduction gearboxes. We may note the receipt of a second order for worm reduction units, ranging from 3- to 18-in. centres, with cast steel cases, required for Davy and United rolling mills for the Duragpur steel plant in India. Special double-reduction worm gear units of 18- and 15-in. centres are in hand for coal washing plant, and vertical agitator units for the chemical industry. Recent overseas business includes orders from Canada, New Zealand, Holland and Belgium. A Gleason 24-in. bevel gear generator has lately been installed. Arrangements have been made for a display of the firm's products to be included on the Board of Trade and Birmingham Exchange and Engineering Centre Stand at the National Industrial Production Show of Canada, to be held in Toronto from May 4 to 8, 1959.

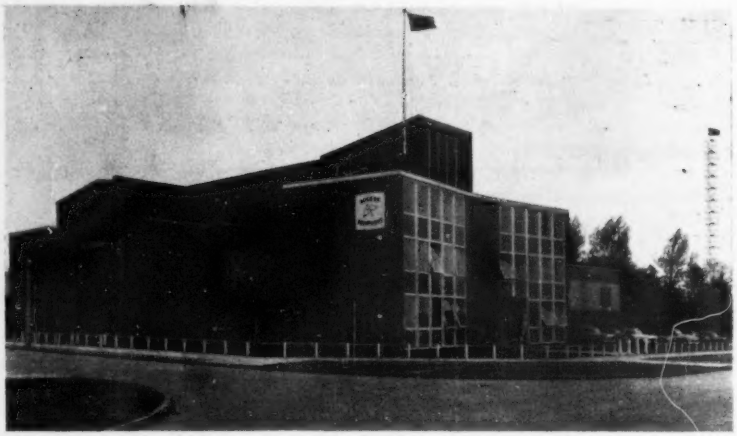
SANDERSON INSTRUMENTS (HUDDERSFIELD), LTD., Prospect Street, are doing a good business in all types of vernier measuring instruments. Orders in hand cover various sizes of vernier calipers, height and depth gauges, and gear tooth calipers. In addition, instrument and micrometer repair work is being undertaken. Other products include graduated machine scales and dials, and glass-cutting gauges.

TAYLOR & JONES, LTD., Honley, are fully occupied on home and export orders for their various types and sizes of reamers. The range includes expanding hand reamers and reamers with fixed pilots, provided with patent high-speed steel helical blades as well as straight blades. We may also note orders for machine and shell reamers, of the expanding type, solid hand and machine reamers, and valve reseating cutters. Export orders have recently been received from South Africa and India.

J. GOULDER & SONS, LTD., Kirkheaton, are experiencing a steady demand for jigs, fixtures, moulds and tooling equipment, as well as for a variety of components, required by the aircraft industry. Orders are also in hand for the full range of rolling gear testing machines, and machines of this type have recently been supplied to Canada, U.S.A., Australia, France, Spain, Italy, Yugoslavia, and Japan. Among the new machine tool plant recently installed we noted a Matrix thread grinding machine, a Churchill 24- by 72-in. universal grinder, and Dean, Smith & Grace lathes of 17- and 21-in. swing.

RELIANCE GEAR CO., LTD., Union Street, inform us that there is a lively demand for the cutting of spur, bevel and worm gears, and for standard 5- and 7½-in. centre worm reduction units. Fine

pitch precision gears are one of the firm's specialities and these are being produced to Admiralty Class 1 limits, also for use in various instruments and servo mechanisms. Other activities include repetition and general machining also capstan lathe work, and additional fitting capacity is being provided for the manufacture of electrical actuating gear. Recent plant additions include a Mikron 102 gear hobbing machine, a Sykes special V10A gear shaping machine for high precision work, a Gleason 3-in. straight bevel gear generator, and tooth rounding and gear lapping machines. These works are to be transferred, on September 15, to larger premises at St. Helens Gate, Almondbury, Huddersfield.



The new works and offices of Access Equipment, Ltd., at Hemel Hempstead

HUDDERSFIELD GAUGES, LTD., Waterloo, report a good call for their various types of precision measuring instruments, including vernier calipers, height and depth gauges, gear tooth calipers and straightedges up to 15 ft. long. We may note recent orders from the Admiralty and Ministry of Supply. There is also a steady flow of orders for Keith combination slip gauge blocks, comprising 81 and 48 pieces, as well as for the smaller mechanics and micrometer sets. The servicing and repairing of all types of precision measuring instruments, including micrometers and comparators, is being carried out on an increasing scale.

H. B.

New Works of Access Equipment, Ltd.

The production of staging units, mobile hydraulic working platforms, freight loaders, and several types of mechanical handling equipment, is being undertaken on an increasing scale at the new works of Access Equipment, Ltd., Maylands Avenue, Hemel Hempstead, Herts., a view of which is given in the accompanying illustration.

A ground floor of 18,000 sq. ft. is supplemented by a further 10,000 sq. ft. of working space on a gallery at first floor level, and the area available for production is already utilized to capacity. Plans have therefore been made to double the size of the existing premises. Equipment installed includes a Rushworth 8-ft. by ¼-in. capacity guillotine; a Hermes metal bandsaw; a B.O.C. universal 36-in. profile flame cutting machine, also electric arc and gas welding equipment; a Ratzer 12-ton press; and a range of general-purpose machine tools. A system of bus-bar trunking, for the power supply, extends throughout the workshop area, and fluorescent lighting is provided on a generous scale.

The company is experiencing an increasing demand for the patented Zip-Up staging products which are manufactured under licence from Upright Scaffolds, Inc., U.S.A. Staging units are made in different sizes to suit various applications, and among the advantages claimed for this equipment are ease and speed of erection, good portability, and high strength/weight ratio of the light alloy used for all parts except the locking pins, which are of stainless steel. A typical tower made from 17 standard Zip-Up sections, having a combined height of 100 ft., may be seen on the extreme right of the illustration. This tower, erected in 2½ hours, is restrained by wire rope guys. Staging units, some of which are mounted on castors, are used extensively to provide working platforms in factories, mills, and machine shops, also on outside locations.

Another well-known product of the company is the Beanstalk platform, which is elevated hydraulically and will carry one or two people to heights up to 41 ft. above floor level. There is also a Safety Raiser, which takes the form of a platform, measuring 7 ft. by 3 ft., supported on an adjustable scissor-type framework designed to open and close under hydraulic control. In this manner, the

height of the working surface can be varied over a range of 4 ft. 6 in., 5 ft., or 8 ft. 6 in., depending on the size of the unit. This type of platform is used extensively for servicing aircraft and the rudders and propellers of ships in dry dock. The Freight Loader, for weight lifting and carrying, comprises a lorry chassis of standard type to which is attached a truck body supported on scissor arms, and controlled, as described previously, by hydraulic power. The truck body is easily raised into line with the door of an aircraft, and heavy or bulky parts can thus be readily loaded or unloaded.

Another working platform, known as the Giraffe, can support four men at the end of an articulated arm, at heights up to 42 ft. The platform height is adjusted hydraulically, either from the platform or ground level. For workshop and stores use, a lifting platform, supported on castors, is fitted to a ram which will raise loads up to 2,000 lb. This handling equipment is employed, for example, for moving large tools between stores and presses.

New Salterpak Package Testing Dept.

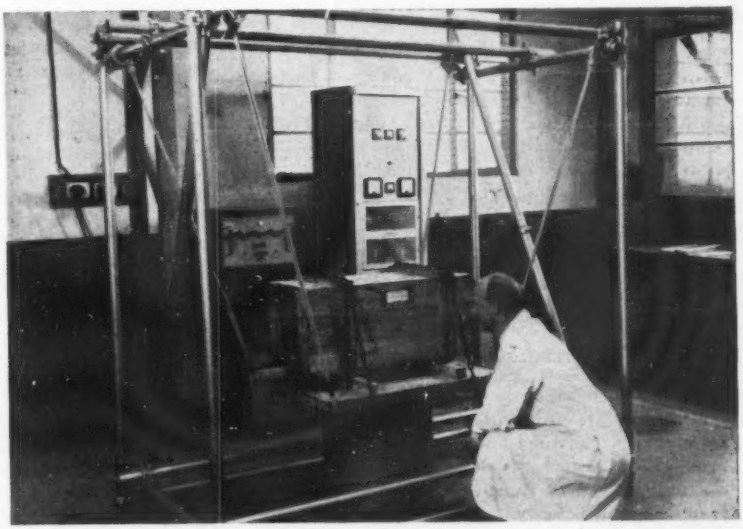
The Salterpak Division of Geo. Salter & Co., Ltd., occupies a factory at Spring Road, Smethwick, and specializes in the packaging, notably for the Ministry of Supply, of precision equipment, which requires to be stored for considerable periods without damage.

A new department has now been established by the Division for the development and testing of packaging techniques for a variety of products such as precision measuring machines, and electronic and aircraft control equipment, which may require to be transported over long distances to different countries. Equipment has been installed for carrying out various tests which simulate certain handling and climatic conditions, to ensure that the container and packaging materials employed will afford sufficient protection for the product while in transit. This equipment facilitates the design of containers of sufficient strength and durability, but not of excessive size and weight.

For one test, the container is dropped freely, usually from a height of 4 ft. 6 in. which corresponds to the loading height of a lorry or waggon, and the force of deceleration on the product when the container strikes the floor is measured electronically by an accelerometer. In this way, the effectiveness of different cushioning materials can be assessed. On a bump testing machine a container is allowed to fall through a distance of 1 in. at the rate of four times per sec. to simulate conditions in a badly-sprung lorry travelling over rough road surfaces. When the container is opened for inspection of the product, any " shake-down " of the packaging material can be observed.

The equipment shown in the figure enables the effects of vibration over a wide range of frequencies and amplitudes to be examined, and the natural resonance of any springs in the product can be determined.

In a large-capacity humidity test chamber, temperatures up to 140 deg. F. with a relative humidity up to 100 per cent can be obtained. Dry-heat tests of containers is undertaken at temperatures up to 140 deg. F. in a room 22 ft. long by 20 ft. wide by 11 ft. high, which has an air-lock chamber to reduce loss of heat to an adjoining shop when people are entering and leaving. Stated to be the largest of its type in the country, this test room was



This vibration-generating machine is installed in the new Salterpak package-testing department

provided by the Salterpak Division some time ago, and is often employed for thoroughly drying equipment before it is packed.

On an outdoor site, provision is made for testing the water-proofing characteristics of lining materials, and the impact resistance of packing cases. For the former test, water is directed on to the packing case at the rate of 100 gal. per min., and a pressure of 60 lb. per sq. in. to simulate a tropical rain storm. For impact testing, the packing case is loaded on to a truck, which, upon release of a quick-acting coupling, runs freely down a pair of inclined rails. At the lower end, the packing case strikes a concrete block to simulate conditions to which it would be subjected if it were swung against a ship's side by a crane.

New Plessey Type UK-AN Connectors

A new range of multiple-pin electrical connectors, which are fully interchangeable with plugs and sockets in the American AN and MS series, has been introduced by the Plessey Co., Ltd., Electrical Connectors Division, Cheney Manor, Swindon, Wilts. Designated the UK-AN type, these connectors conform to various specifications, including the Ministry of Supply EL 1884 and Radio Component 321, and simplification of design, with some standardization of dimensions, has permitted a considerable reduction to be made in the number of individual components required.

The connectors have successfully passed moisture tests up to 100 per cent humidity and they will operate satisfactorily at temperatures from −65 to +190 deg. C. While carrying the full rated current, sample units have resisted a flame temperature of 1,100 deg. C. for a period of 15 min., and they can withstand a voltage of 5 kV. at sea level and some 2·5 kV. at an altitude of 70,000 ft. Plug pins and sockets are silver-plated, and wiring connections, which are made before the connectors are assembled, can be crimped or soldered, as required. Interior mouldings are of silicone rubber, and the bodies, which can be supplied with or without a flange for panel mounting, are of aluminium.

The Radio Show

The British Radio and Television Exhibition, now in progress at Earls Court, affords evidence of important advances which have resulted from intensive technical development in various directions. The use of transistors and printed circuits is no longer a novelty, and wide-angle cathode-ray tubes are also contributing to the increasing compactness of domestic television sets. The technique of stereophonic sound is now established and stereophonic records are being publicly demonstrated for the first time. The two sound tracks necessary for stereophonic reproduction are combined in a single groove. During recording, the two signals operate the cutting stylus in directions at right angles, each at 45 deg. to the surface of the record. For playing, the pick-up stylus is connected to two piezo-crystal cells or other generator devices, each of which responds to movements in one direction. In this way the binaural channels are separated, and then amplified. After amplification the output from each generator is led to a separate speaker. Since the lowest notes are not directional, only one of the two speakers need be a full-range type.

There are various exhibits of general and national interest, and the display by the Radio Industry Council is a model of the Jodrell Bank radio telescope. Reference may also be made to some sound and vision recordings of the Sputnik signals received by the Cambridge radio telescope, and to a display of guided weapons by the R.A.F.

As an indication of the importance of electronic equipment for military purposes, it is stated that the cost of such equipment for a cruiser is now £500,000 and for an aircraft carrier, more than £1,000,000.

Books Received

CABMA Register of British Industrial Products for Canada, 1958/1959. Published jointly by Kelly's Directories, Ltd., 186 Strand, London, W.C.2, and Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, for the Canadian Association of British Manufacturers and Agencies. 653 pp. (15s., post free).

In this sixth edition of the annual Register, emphasis is laid upon the needs of Canada for capital and industrial goods of British manufacture. Some 3,200 British products, and their suppliers, are listed alphabetically, and details are included of the distribution arrangements in Canada of nearly 4,000 British firms. The Register is arranged in six main sections, which are thumb-indexed, and the title page of each section is in English and French.

Lifting and Carrying and Safety Devices for Hand- and Foot-operated Presses. Ministry of Labour and National Service. Obtainable from H.M. Stationery Office. (1s. and 2s. 6d. respectively.)

The first-mentioned of these booklets offers advice concerning the correct and incorrect methods of manually lifting and carrying in industry, from the standpoint of avoiding accidents due to muscular strain. The second book is comprehensively illustrated with photographs and line drawings, and gives numerous examples of the different types of mechanically-operated safety guards which can be fitted to presses of the hand- and foot-operated types. It is pointed out that the dangers associated with such presses are often not appreciated. In one year, 691 accidents involving disablement for more than three days occurred on hand presses, and 231 on foot presses.

Newall Spacematic Jig Boring Machine Demonstration

Reference has already been made in MACHINERY, 88/1176—22/6/56, to the Newall Spacematic jig boring and milling machine, which incorporates the B.T.H. automatic co-ordinate setting and control system, based on the used of punched cards. This system was described in an earlier article, 88/519—20/4/56. A demonstration of the latest version of the machine, shown in Fig. 1, was arranged recently by the Newall Engineering Co., Ltd., Peterborough. Built for Rolls-Royce, Ltd., it is additionally equipped for tracer-controlled two-dimensional copy milling, and "staircase" milling, and the equipment includes the horizontal boring spindle attachment shown in Fig. 2. This unit, which is another recent development by the company, can also be fitted to the type 2442 jig borer.

The attachment comprises a 2⅝-in. diameter spindle, which is, in effect, a replica of the Newall type 2436 jig borer spindle, mounted in a cast housing designed to fit directly on to an accurate flat locating surface on the bottom of the feed box. This housing passes over the lower end of the standard vertical spindle, from which the drive to the horizontal spindle is transmitted through a coupling, and a pair of bevel gears of approximately 1:1 ratio. A range of steplessly variable speeds from zero to 2,000 r.p.m. is thus obtained. The spindle of the attachment runs in S.K.F. ultra-precision, double-row, cylindrical roller bearings. Clamping and release of tools is effected by a quarter-turn of a captive nut, and the spindle nose has a taper of 10 deg. included angle.

To facilitate mounting the attachment, a horizontal face is provided on the bottom of the housing which may be placed on a suitable support on the machine table. The feed box is lowered to engage the main spindle, and the attachment is then bolted to the flat locating face earlier mentioned. Provision is made for mounting the attachment in three alternative positions, namely, with the spindle nose pointing to the right or left, or towards the front of the machine. A flat datum surface is provided on the side of the housing, parallel with the spindle, to enable the latter to be aligned accurately with either of the table motions, with the aid of a dial gauge mounted on the table.

Height adjustment is effected by raising or lowering the feed box, either by means of rapid power traverse, or the handwheel. The latter gives a movement of 0·05 in. per rev., or 0·001 in. per scale division. If a more accurate setting is required, reference is made to a dial gauge which reads to 0·0001 in. The handwheel is coupled to the traversing screw through a clutch, and a safety interlock ensures that power traverse cannot be brought into operation when the clutch is engaged. When the attachment is set up on the machine, a further interlock becomes effective,

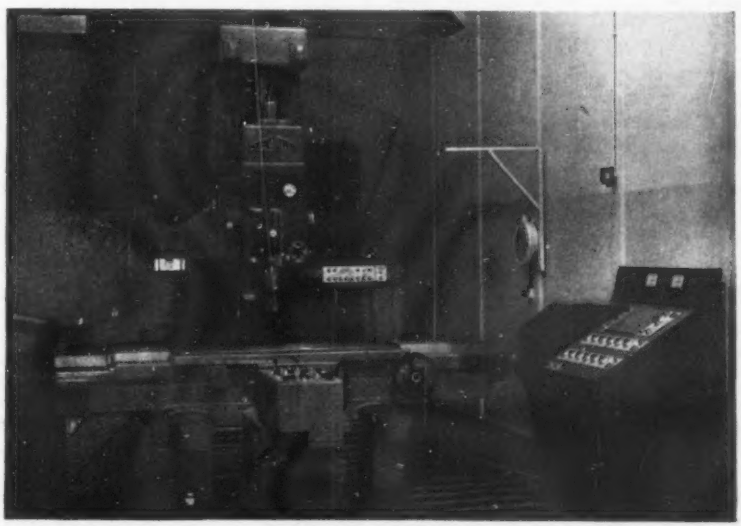


Fig. 1. Latest type Newall Spacematic jig borer, equipped for tracer-controlled copy milling, "staircase" milling, and horizontal boring

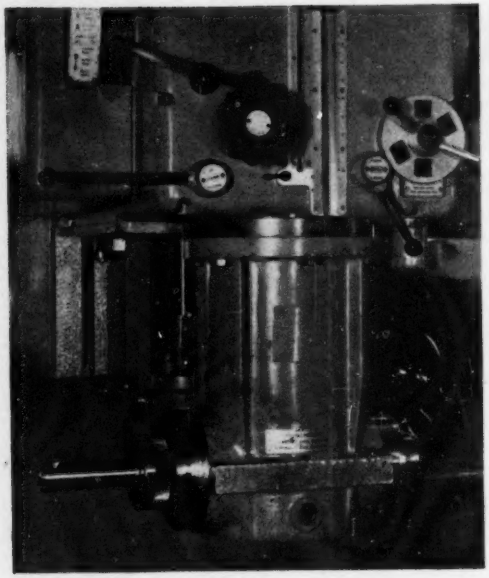


Fig. 2. The recently-introduced horizontal boring head, which can also be fitted to the Newall type 2442 jig borer

which makes it impossible to engage the vertical motion of the quill accidentally. Power feed is provided by the table motions, both of which are steplessly variable from ¼ in. to 12 in. per min.

The B.T.H. 2-dimensional tracer unit for copy milling affords a constant rate of cutting feed, which is steplessly variable from ¼ in. per min. to 6 in. per min., and a further speed range of 6 in. per min. to 36 in. per min. can be used in conjunction with a manual "steering" control. Contact pressure of the tracing stylus on the template is constant at 4 oz., and it is stated that profiles can be copied with errors of less than 0·0005 in. A cutter compensation control is provided, whereby allowances can be made for variations in cutter diameter from nominal, and for eccentricity. Feed in either direction may be selected, for "climb" or conventional milling, and change-over from automatic positioning to tracer control is made by means of a single switch. Work can thus be profiled and bored at one setting.

The various controls are mounted on the console at the front of the machine, and the auxiliary table for the template is mounted on the left-hand end of the main table. To ensure rigidity, the copying area is restricted to 26 in. by 26 in., but in certain circumstances, one of these dimensions may be increased. The copying table is adjustable through a distance of 2 in., longitudinally and transversely. Associated electrical control gear, and a small high frequency alternator, are in the existing cubicles, so that no additional floor space is required.

"Staircase" milling is a development whereby profile milling can be carried out under numerical control, by means of punched cards. In this instance, the table is moved to successive positions along alternate co-ordinates, and the milling cut is taken during each such movement. By keeping these movements sufficiently small, commensurate with a reasonable operation time, and employing a cutter of suitable diameter, a nearly smooth profile can be generated, with a high degree of accuracy. In one instance, a piece of ½-in. gauge plate was machined in this manner to a radius of 5½ in. with a 2½-in. diameter cutter, in roughing and finishing stages. For roughing, the co-ordinate spacing was 0·08 in., and for finishing, 0·02 in. On the finished piece, the maximum ripple height was 0·00008 in., and the profile was within ±0·00015 in. of the true circular form. The length of the profile was approximately 8¾ in. long, and the total machining time was 92 min. These developments, and some of the design features of the Spacematic machine, will be discussed in greater detail in a later article.

Matched Machining

(*Continued from page* 511)

spool and sleeve are set up simultaneously on the machine, between separate pairs of centres and each is observed through a microscope, the port edges in the sleeve being viewed through the adjacent ports. A datum position for each component is established, and thereafter they remain in a fixed relationship while the side faces of the lands are ground. For each face, the spool microscope is set to indicate the required overlap by means of a micrometer and 50 : 1 pantograph which provides for very fine adjustment.

When the spool is ground in this manner, the valve will sometimes pass the flow test without further correction. Usually, however, a single correcting operation is required and at this stage the additional material removed is controlled, with reference to an air gauge, to ±10 micro-inches.

No doubt similar arrangements could be developed to enable critical accuracy requirements to be satisfied in connection with some other, more complicated assemblies. The great merit of this system is that direct account is taken of the effects of all cumulative errors so that the necessity for holding individual dimensions to exorbitantly close limits may be avoided.

Industrial Notes

ELCONTROL, LTD., Wilbury Way, Hitchin, Herts., have transferred their sales office and service staff, formerly accommodated in London, to their works at the above address.

KELVIN & HUGHES, LTD., inform us that their executive offices have been transferred to new premises at Empire Way, Wembley, Middlesex (telephone number, Wembley 8888).

BIRLEC, LTD., Tyburn Road, Erdington, Birmingham, 24, have established a Johannesburg branch office under the management of Mr. S. G. King. The address is P.O. Box 99, Witfield, Transvaal.

AN AUCTION SALE OF MACHINE TOOLS, plant, and miscellaneous Stores, etc., will be held at M.O.S. Storage Depot, Harrogate Road, Yeadon, Leeds, on September 23. The auctioneers will be Dacre, Son & Hartley (Dept. N), Station Road, Otley, Yorks.

PARSONS MARINE TURBINE CO., LTD., Wallsend-on-Tyne, have entered into an agreement for technical collaboration with the Swiss firm, Brown Boveri & Co., Ltd., and the French firm, Compagnie Electro-Mecanique, in the design and construction of marine steam turbines.

THE INDUSTRIAL WELFARE SOCIETY, Robert Hyde House, 48 Bryanston Square, London, W.1, has arranged a 2-day conference, to be held on October 14 and 15 to provide an opportunity for men and women office managers to discuss the problems encountered in the course of their work.

E.M.B. CO., LTD., Moor Street, West Bromwich, Staffs., have issued an interesting and informative history in connection with the 50th anniversary of the founding of the business. There are six chapters, each of which covers a period of years, and some typical products of the various periods are illustrated and discussed.

THE PLESSEY CO., LTD., Cheney Manor, Swindon, Wilts., have formed a special department to ensure the speedy despatch of small quantities of standard electrical connectors when these are required urgently for prototype, or similar, work. To facilitate identification, specially-printed stickers are to be issued which can be attached to customers' order forms, and, whenever possible, orders will be executed by return of post.

CONE AUTOMATIC MACHINE CO., LTD., Aldridge, Staffs., are to exhibit a British-built 1⅝-in., 6-spindle, type TA Conomatic at the forthcoming Milan Exhibition. In order to avoid boxing and transhipment *en route*, this machine has been despatched direct by road from the company's works to the Exhibition. Once on the lorry, the machine will not be touched until it reaches Milan, and the journey, of approximately 800 miles, is believed to be the largest Continental road delivery yet made from this country.

CROMPTON PARKINSON, LTD., Crompton House, Aldwych, London, W.C.2, inform us that their T series range of fractional-h.p. electric motors are now available with oil burner flanges. This new range of motors complies with the dimensions laid down by the American N.E.M.A. standards, and is available, in the drip-proof type, in sizes ranging from ⅛ to 0·95 h.p. for 3-phase supply; and ⅛ to ½ h.p., for single-phase supply. For the totally-enclosed form, the h.p. ratings are ⅛ to ½ h.p. for 3-phase, and ⅛ to ½ h.p. for single phase.

THE PLASTICS DIVISION OF I.C.I., LTD., Millbank, London, S.W.1, are to organise an exhibition to illustrate the industrial uses of nylon. Among the items on show will be representative components from the motor-car, textile, and electrical industries, also items from various mechanisms and domestic appliances. The exhibits will be on view at the Chamber of Commerce Assembly Rooms, Birmingham, on September 23 and 24; the Angel Hotel, Cardiff, on October 14 and 15; and the Grand Hotel, Charing Cross, Glasgow, on October 29 and 30.

RANK-XEROX, LTD., 33/41 Mortimer Street, London, W.1, have increased the range of their xerographic copying equipment by the introduction of the type 1318. Particularly intended for copying engineering drawings, this equipment will produce a direct copy (or translucency), for use with a dyeline process, or, alternatively, an offset litho master, from drawings, charts, operation sheets, and specifications, for example, up to a maximum size of 8½ by 13 in. The transfer unit of this new equipment will be on show at the forthcoming Business Efficiency Exhibition to be held at the City Hall, Manchester, from September 22 to 27.

The Price of a Subscription to MACHINERY is 52 Shillings per annum, post free, to any part of the world.

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3/9/58

British Standard for Turbine Gears

British Standard 1807 : Part 2 : 1958 (gears for turbines and similar drives—tooth form and pitches) specifies tooth forms based on 20- and 16-deg. pressure angle basic rack profiles, and those produced by a hob of 16-deg. flank angle in the axial plane. (The latter form is the one developed by the marine gearing industry.)

A table relating to 20- and 16-deg. pressure angle basic rack tooth profiles lists normal diametral pitch, normal pitch and module. There is a second table which gives pitches in terms of the axial pitch of the hob.

Part 1 of this standard was published in 1952 and dealt with accuracy.

Copies of Part 2 may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1 (price 4s.—postage extra to non-subscribers).

Coventry Refrigerator Merger Target

Coventry Refrigerator Co., Ltd., incorporating Austic-Layton Machine Tools, have merged with Target Engineering Co., Ltd., of Southbourne, Bournemouth, and will operate in future under the name of Target Engineering, Ltd. The combined facilities now available at Northfield Road, Coventry, telephone Coventry 22256, 22280, will satisfy the demand for Copymax mechanical profiling attachments. In addition, the large drawing office and well equipped machine shops enable other work to be undertaken, including the design and production of special-purpose machines, jigs and fixtures, and press tools, also contract machining, and the production of prototypes and refrigerator condensing units. The company is A.I.D. approved.

Materials Handling Convention

A materials handling convention organized by the Institution of Production Engineers, 10 Chesterfield Street, London, W.1, will be held at the Hotel Metropole, Brighton, from October 13 to 15, 1958. Subjects for visits and discussions will include: problems of handling containers, cases and packages; large articles for batch production; and small articles for mass and batch production; also problems associated with the maintenance of product quality, and with parts of awkward shape.

Personal

CAPTAIN R. L. JORDAN, formerly engineer manager of the Royal Naval dockyard at Chatham, has been appointed a director of Fawcett, Preston & Co., Ltd., Dock Road, Bromborough, Cheshire. MR. A. J. TAYLOR has been appointed contracts manager for the same company, which is a member of the Metal Industries Group.

MR. N. S. BILLINGTON, M.Sc., M.I.H.V.E., has been appointed director of the Heating and Ventilating Research Council, and has been succeeded in his former position as head of the National College for Heating, Ventilating, Refrigeration and Fan Engineering by DR. DAVID R. SCOTT, a senior lecturer at the Royal College of Science and Technology, Glasgow.

MR. S. WALKER has relinquished his post as managing director of Laycock Engineering, Ltd., Millhouses, Sheffield, 8, on reaching retiring age, and has been appointed vice-chairman of that company. He has also been appointed to the board of Birfield, Ltd., Stratford House, Stratford Place, London W.1. MR. W. E. THOMPSON and MR. K. WALKER have been appointed joint general managers of Laycock Engineering, Ltd.

Scrap Metals

†LONDON.—‡Prices per ton for non-ferrous scrap metals free from iron are as follows:—clean copper wire, untinned and free from lead and solder, £163; clean heavy copper, untinned and free from lead and solder, £157; copper, wire, No. 2, £150; clean light copper, £145; braziery copper, £129; gunmetal, £132; brass, mixed, £93; lead, net, £54; zinc, £29; cast aluminium, £87; old rolled aluminium, £110; battery lead, £28; unsweated brass radiators, £81; hollow pewter, £495; black pewter, £365.

MIDLANDS.—The movement of scrap to home markets is still very restricted and merchants are hard pressed to find outlets for all grades. There is much activity in connection with scrap for export but full details of prices and specifications are still under consideration. It appears that prices are not very attractive, but with yards full to overflowing many merchants will be content to ease stocking problems by exporting certain grades under licence.

Heavy steel to specifications No. 1 and 2 cannot be placed locally, and only odd loads are being consigned to steelmakers in other areas. A large tonnage of chipped turnings is produced each week in the Midlands and it is now impossible to move all the loads directly to consumers. Loads are either being put on the ground in yards or held in railway wagons, under demurrage, until allocations improve.

Cast iron borings are being moved steadily to blast furnaces and chemical works but cast iron for foundries is more difficult to place. Light scrap for pressing is only taken at yards in limited quantities, and the prices offered are very low.

With the repeal of the Scrap Control Order it is expected prices will not be stabilized until new orders are arranged in October or November. At present steelworks are paying normal prices, but allocations are so meagre that merchants' prices have been reduced to allow for storage, etc.

Current maximum control prices, delivered consumers' works, are now: *Heavy steel No. 1, 217s. 6d.; *heavy steel No. 2, 196s.; *heavy steel No. 4, 207s. 6d.; *heavy steel No. 5, 195s. 6d.; light iron No. 8, 149s.; short turnings No. 9 (free from alloy), 167s. 3d.; light steel No. 11, 164s. 3d.; bushy turnings, 117s.; short alloy turnings, 160s. 9d.; short steel No. 2, 233s. 3d.; machinery cast, 233s.

Prices may be increased up to 2s. 6d. per ton according to quantities tendered over a given period.

* For use by Round Oak Steelworks, Brierley Hill, increase by 1s. 6d. per ton.
† George Cohen, Sons & Co., Ltd., 600 Commercial Road, E.14.
‡ Subject to market fluctuations.

Machine Tool Share Market

Active and buoyant conditions prevailed in most sections of the stock markets during the period under review, and although an irregular tendency developed towards the close, the general undertone remained firm.

The gilt-edged section, however, was subdued, and mainly owing to lack of buying interest, quotations for British Funds also for home corporation and Commonwealth stocks drifted to lower levels.

Commercial and industrial share markets displayed strength for the most part, but became irregular, and ended on a quieter note. Nevertheless, gains on balance were numerous and well spread.

Among machine tool issues Arnott & Harrison advanced 1s. 3d. to 15s.; Birmingham Small Arms, 6d. to 32s. 6d.; Churchill Machine Tool, 6d. to 19s. 6d.; John Harper, 6d. to 14s. 7½d.; Chas. Churchill, 3d. to 5s. 1½d.; Sheffield Twist Drill, 3d. to 11s. 9d.; Alfred Herbert, 1s. 3d. to 37s. 6d.; A. A. Jones & Shipman, 1s. 9d. to 23s.; Noble & Lund, 1s. to 3s. 9d.; Thos. W. Ward, 1s. to 80s.; Samuel Osborn, 9d. to 20s.; and John Shaw & Sons (Wolverhampton), 1½d. to 12s. 9d. On the other hand, British Oxygen lost 6d. at 39s. 6d.; Geo. Cohen, 3d. at 11s. 6d.; Expert Tool, 3d. at 1s.; and Kitchen & Wade, 3d. at 9s. 3d.

B. ELLIOTT & CO., LTD.—Final dividend 22½ per cent on the increased ordinary capital, making, with the interim already paid, a total distribution of 30 per cent for the year ended March 31 last (same).

Trade Publications

WOODHOUSE EQUIPMENTS, LTD., Woodequips Works, David Road, Colnbrook, Bucks. Catalogue, extending to 55 pp., giving comprehensive details of the 77 different tool kits made by the company for the engineering and allied trades.

ALLEN WEST & CO., LTD., Brighton. Publication No. 1782 gives illustrations and descriptions of a range of built-in flush-mounted starters. Also included are typical examples of multi-motor panels which have been built to special order.

METALECTRIC FURNACES, LTD., Cornwall Road, Smethwick, 40, Staffs. Leaflet M21a describes the range of bench-type muffle furnaces B.T.1, 2, and 3, which have ratings of 1·8, 3·0 and 5·4 kW., respectively. These furnaces have steplessly-variable temperature control, incorporate temperature indicators, and can be arranged to operate on either single-phase A.C. or D.C. current supply.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	9d.
Armstrongs, Stevens & Son, Ltd.	Ord.	5/-	8/3
Allen (Edgar) & Co., Ltd.	Ord.	£1	33/-
" "	5% Prf.	£1	14/9*
Arnott & Harrison, Ltd.	Ord.	4/-	15/-
Asquith Machine Tools Corp., Ltd.	Ord.	5/-	19/6
" " "	6% Cum. Prf.	£1	18/6
Birmingham Small Arms Co., Ltd.	Ord.	£1	32/6
" " "	5% Cum. "A" Prf.	£1	15/6
" " "	6% Cum. "B" Prf.	£1	17/6
" " "	4% 1st Mort. Deb.	Stk.	87½
British Oxygen Co., Ltd.	Ord.	£1	39/6
" " "	6½% Cum. Prf.	£1	21/6
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	4/1½
Broom & Wade, Ltd.	Ord.	5/-	11/7½
" "	6% Cum. Prf.	£1	17/9
Brown (David) Corporation Ltd.	5½% Cum. Prf.	£1	14/-
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/9
Butler Machine Tools Co., Ltd.	Ord.	5/-	6/6
" "	5% Cum. Prf.	£1	13/9
C.V.A. Jigs, Moulds & Tools, Ltd.	5½% Red. Cum. Prf.	£1	13/9
Churchill (Charles) & Co., Ltd.	Ord.	2/-	5/1½
" "	6% Cum. Prf.	£1	26/3
Churchill Machine Tool Co., Ltd.	Ord.	5/-	19/6
" "	6% Cum. Prf.	£1	18/6
Clarkson (Engrs.), Ltd.	Ord.	5/-	14/-
Cohen (George), Son & Co., Ltd.	Ord.	5/-	11/6
" "	4½% Cum. Prf.	£1	14/6
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	14/1½
" " "	5% Cum. Red. Prf.	£1	16/3
Coventry Machine Tool Works, Ltd.	Ord.	4/-	8/3
Craven Bros. (Manchester), Ltd.	Ord.	5/-	6/7½
Elliott (B.) & Co., Ltd.	Ord.	1/-	3/3
" "	4½% Red. Cum. Prf.	£1	13/9
Expert Tool & Case Hardening Co., Ltd.	Ord.	1/-	1/-
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	12/6
Greenwood & Batley, Ltd.	Ord.	£1	48/1½

COMPANY		Denom.	Middle Price
Harper (John) & Co., Ltd.	Ord.	5/-	4/7½
" "	4½% Red. Cum. Prf.	£1	13/1½
Herbert (Alfred), Ltd.	Ord.	£1	37/6xd
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	11/6
	"B" Ord.	5/-	11/6
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	23/-
" "	7% Cum. Prf.	5/-	5/-
Kayser, Ellison & Co., Ltd.	Ord.	£1	45/-
" " "	6% Cum. Prf.	£1	18/3
Kendall & Gent, Ltd.	Ord.	5/-	7/7½
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	6/3
Kitchen & Wade, Ltd.	Ord.	4/-	9/3
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/4½
Massey, B. & S., Ltd.	Ord.	5/-	8/3
Modern Engineering Machine Tools Ltd.	Ord.	5/-	10/7½
Newall Engineering Co., Ltd.	Ord.	2/-	4/9
Newman Industries, Ltd.	Ord.	2/-	2/3
" "	6% Prf. Ord.	5/-	5/6
Noble & Lund, Ltd.	Ord.	2/-	3/9
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	20/-
" " "	5½% Cum. Prf.	£1	25/9
Pratt (F.) & Co., Ltd.	Ord.	5/-	21/3
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	5/-
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	37/6
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	12/9xd
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	11/9
" " " "	5% Cum. Prf.	£1	15/-
Stedall & Co., Ltd.	Ord.	5/-	6/3
Tap & Die Corporation, Ltd.	Ord.	5/-	8/-
" " "	4½% Deb. 1961-1977	Stk.	82/-
Wadkin, Ltd.	Ord.	10/-	17/6
Ward (Thos.) W.), Ltd.	Ord.	£1	80/-
" "	5% Cum. 1st Prf.	£1	15/9
" "	5% Cum. 2nd Prf.	£1	24/-
Willson Lathes, Ltd.	Ord.	1/-	2/4½

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. † Birmingham price.

PRICES OF MATERIALS

All prices per ton except where otherwise stated.

Pig-Iron

Foundry and Forge No. 3, Class 2

Middlesbrough zone	£21 6 0
Birmingham	£20 18 3

Phos. 0·1 to 0·75%

Birmingham	£23 17 0

Scottish Foundry

Grangemouth	£25 3 6

Hæmatite English No. 1

N.E. and N.W. Coast	£25 6 6
Scotland	£25 13 0
Sheffield	£26 15 0
Birmingham	£27 4 0

Welsh

£25 6 6

Steel Products

Medium plates	£45 11 6
Mild steel plates, ordinary*	£42 2 0
Boiler plates*	£44 12 0
†Flat bars 5 in. wide and under †Round bars under 3 in.	£40 0 6
Billets, rolling quality, soft U.T.	£32 15 6

Phosphor Bronze

Ingots (2B8) (A.I.D.) d/d £256 0 0

Copper

Cash (mean)	£202 2 6
Cold rolled and hot rolled sheets 4 ft. by 2 ft. by 10 SWG	£270 10s. 0—£270 15 0
Rods $\frac{1}{16}$ in. to $\frac{1}{4}$ in. diam.	£289 5 0
Tubes, 1$\frac{1}{2}$ in. bore by 10 SWG, ton lots, per lb.	2s. 8$\frac{3}{4}$d.
Wire rod, black, hot-rolled ($\frac{1}{4}$–$\frac{7}{8}$ in.) English	£216 17 6

Zinc

Refined, minimum 98 per cent. purity, current month (mean) £63 17 6

Brass

Tubes, solid drawn, per lb.	1s. 7$\frac{1}{2}$d.
Strip 63/37, 6 in. by 10 SWG coils, ton lots	£224 5 0—£226 15 0
Rods, $\frac{1}{2}$–3in. diam. (59 per cent copper)	1s. 9$\frac{1}{2}$d.

Yellow Metal

Condenser plates, per ton	£161 0 0
Rods, per lb.	1s. 10$\frac{1}{2}$d.

Aluminium

Ingots min. 99·5 per cent Canadian d/d	£180 0 0

Lead

Refined, minimum 99·97 per cent purity, current month (mean) £69 17 6

Tinplates

‡U.K. Home trade:

Handmill f.o.t. makers' works	£3 11 8$\frac{1}{2}$
Cold reduced, f.o.t. makers' works	£3 7 4$\frac{1}{2}$

U.K. Export:

Hot rolled basis, f.o.t. works' port	72s. 6d.—75s. 0d.
Cold reduced basis, f.o.t. works' port	75s. 0d.

Gunmetal

Ingots, 85.5.5.5. ex works £170 0 0

* N.E. Coast, N. Joint Area, Central Scottish Zone.

† U.T. soft basic.

‡ Official maximum price, after allowing for adjustments for increase in price of tin.

MAKERS' PRICES

Hexagon Steel Bars[1]

Sizes in inches from 1 in. up to 2·21 and 2·41 a/f, ex works 2 ton basis	£42 17 0
Free cutting black	£47 6 6

Reeled Steel Bars[1]

Single-reeled 1$\frac{1}{2}$ in. upwards, f.o.t. works (+ usual extra for sizes)	£43 9 6
Free cutting	£47 19 0

High-Speed Steel

Black random length bar. All prices basic, per lb., subject to extras.	
Molybdenom " 66 "	5s. 10$\frac{1}{2}$d.
Molybdenum " 46 "	5s. 8$\frac{1}{2}$d.
14 per cent tungsten	5s. 9d.
16 per cent tungsten	6s. 1$\frac{1}{2}$d.
18 per cent tungsten	6s. 4d.
22 per cent tungsten	7s. 5d.
5 per cent cobalt	9s. 6d.
4·75/5·25 per cent molybdenum + 6·0/6·75 per cent tungsten + 1·75/2·05 per cent vanadium (5-6-2)	6s. 0$\frac{1}{2}$d.

Precision-ground, High-speed Free-turning Brass Rod[2]

$\frac{1}{2}$-in. dia. ± 0·00025-in. 2-ton lots, per lb. 2s. 5$\frac{1}{2}$d.

Grey Iron Rod

Die Cast[3] in random lengths 18 in. to 26 in. rough machined $\frac{1}{32}$-in. above listed size. Extra for definite lengths. Discounts for orders over £150.

	Per cwt. net. Mark I	Mark III
$\frac{1}{2}$ or $\frac{5}{8}$in.	245s. 4d.	318s. 10d.
1 or 1$\frac{1}{8}$ in.	196s. 4d.	251s. 10d.
1$\frac{1}{4}$ to 1$\frac{1}{4}$ in.	137s. 10d.	171s. 2d.
1$\frac{3}{8}$ to 2 in.	106s. 2d.	125s. 11d.
2$\frac{1}{8}$ to 3$\frac{1}{8}$ in.	91s. 6d.	106s. 4d.
3$\frac{1}{8}$ to 12 in.	86s. 6d.	99s. 2d.

Continuous Cast

10-ft. lengths, centreless machined 1 to 3-in. dia. + 0·010 to 0·020 in., prices as quoted for die cast bar[3]

6-ft. lengths centreless ground + 0·010 in. Extra for hardenable alloy iron[4] Per cwt. net	$\frac{1}{2}$ or $\frac{5}{8}$ in.	245s. 4d.
	1 or 1$\frac{1}{8}$ in.	196s. 4d.
	1$\frac{1}{4}$ to 1$\frac{1}{4}$ in.	137s. 10d.
	1$\frac{3}{8}$ to 2 in.	106s. 2d.
	2$\frac{1}{8}$ to 3$\frac{1}{8}$ in.	91s. 6d.

Stellite[5]

Welding Rods plain

$\frac{1}{4}$ in. dia. per lb. 30s. 0d.

Toolbits

$\frac{1}{4}$ in. sq. × 4 in., each 22s. 3d.

Precision-ground Mild Steel[6]

1-in. dia. + 0·00025-in. 4-ton lots, per cwt. 121s. 6d.

1 Colvilles, Ltd., Glasgow, and 17 Grosvenor Street, London, W.1. 2 Pratt, Levick & Co., Ltd., Chester. 3 Sheepbridge Alloy Castings, Ltd., Sutton-in-Ashfield. 4 " Flocast," Harold Andrews Sheepbridge, Ltd., Halesowen. 5 Deloro Stellite, Ltd., Highlands Road, Shirley, Solihull.

BASIC PRICES FROM LONDON STOCK[6]

Free Cutting Steel

Bright cold drawn: (Usaspead) over 1$\frac{1}{2}$ to 2 in.	£59 17 6
Lead bearing (Usaled)	£64 4 0
Precision ground, 1$\frac{1}{8}$ in.	£81 13 6

Bright Drawn

M.S. bars (M.M.C.) over 1$\frac{1}{2}$ in. to 2 in.	£55 3 6
Square edge flats (Usaflat)	£72 0 0
M.S. angles (Usaspead)	£99 10 0
Casehardening (EN) (Usacase) over 1$\frac{1}{2}$ in. to 2 in.	£63 9 6
M.S. bars (EN3B) (Usamild) over 1$\frac{1}{2}$ to 2 in.	£57 3 6
Carbon manganese semi-freecutting case hardening (EN202) (Usaspead 202) over 1$\frac{1}{2}$ to 2 in.	£72 19 0
35/45 ton tensile (EN6) (Usen) over 1 to 1$\frac{1}{2}$ in.	£64 17 6
0·4 Carbon Normalised (Usaspead " 40 ") over 1$\frac{1}{2}$ in. to 2 in.	£66 19 6
Carbon manganese steel to Specification EN.16.T (Usaspead 5565), per ton	£127 11 3

Ground Flat Stock

18-, 24-, and 36-in. lengths (Usaspead). List prices less 5 per cent

Oil Hardening Cast Steel

Non-shrink (Usaspead N.S.O.H.) $\frac{1}{2}$ in. to 2$\frac{1}{2}$ in., per lb.	1s. 11d.
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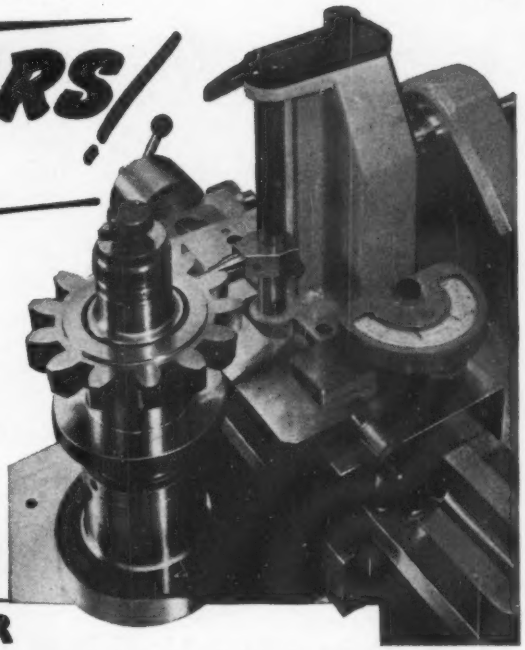

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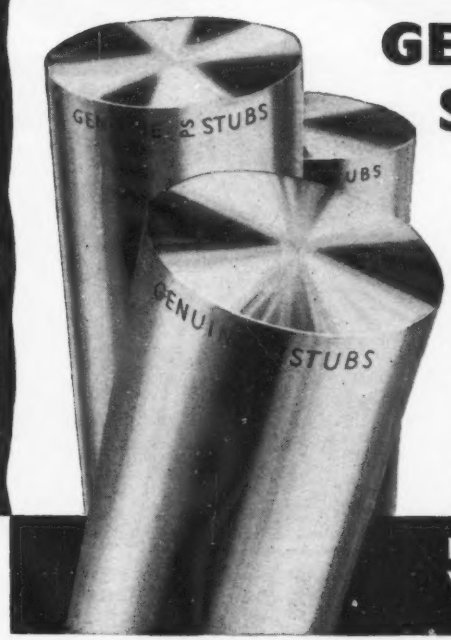

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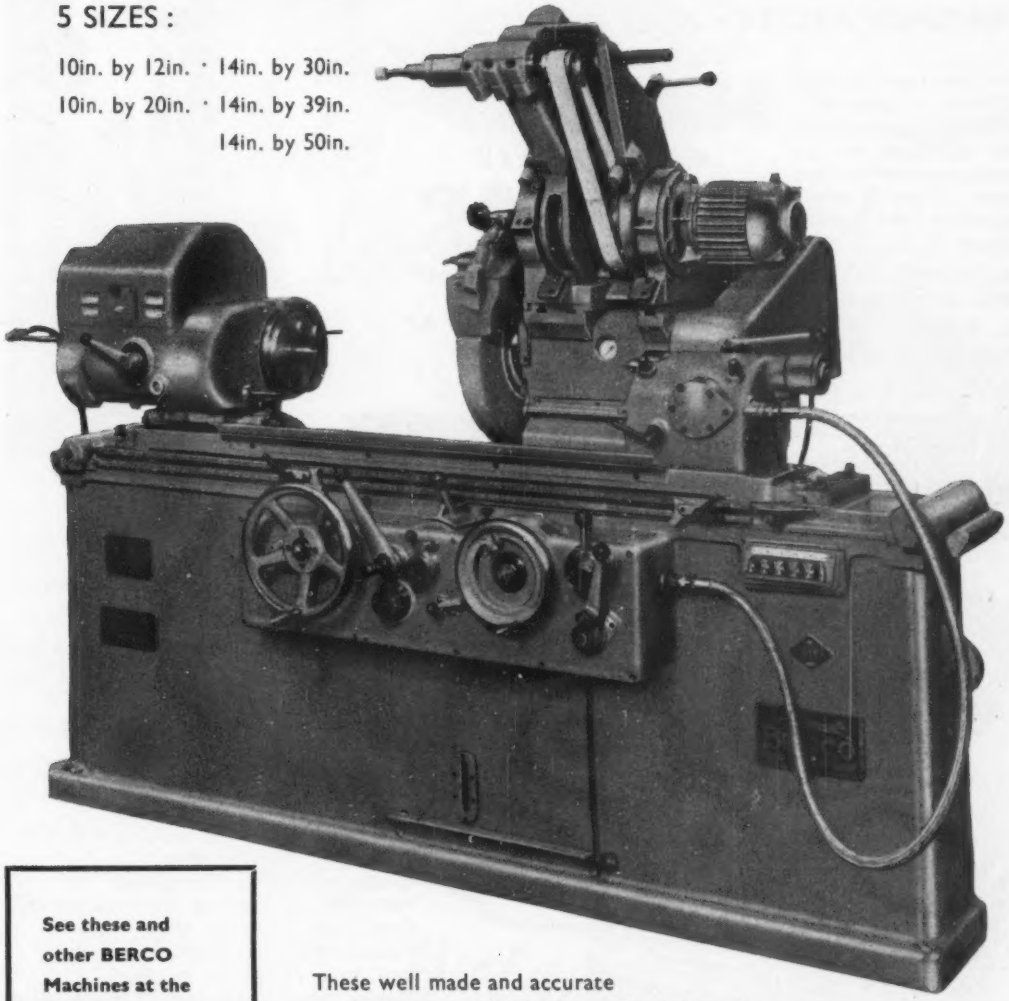

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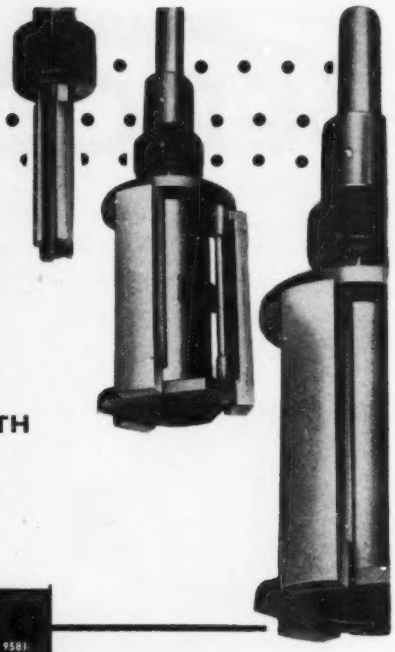

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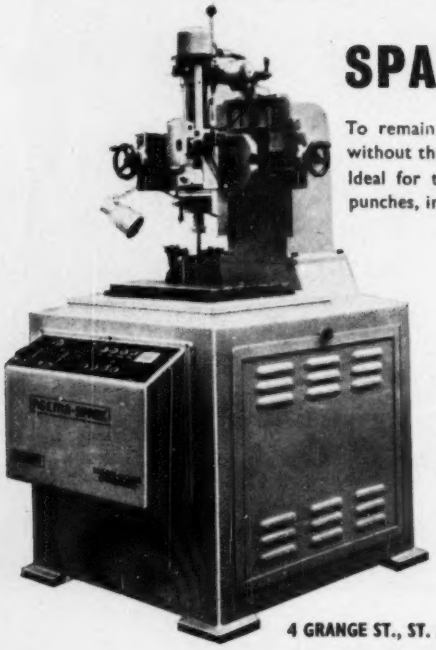

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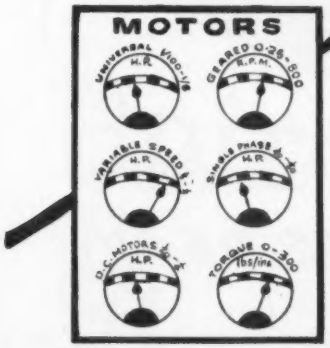

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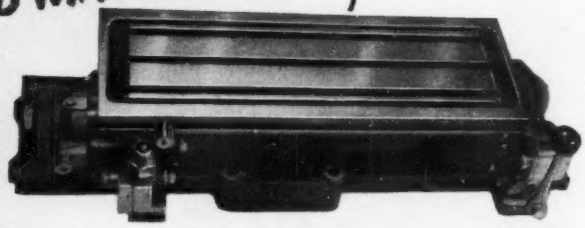

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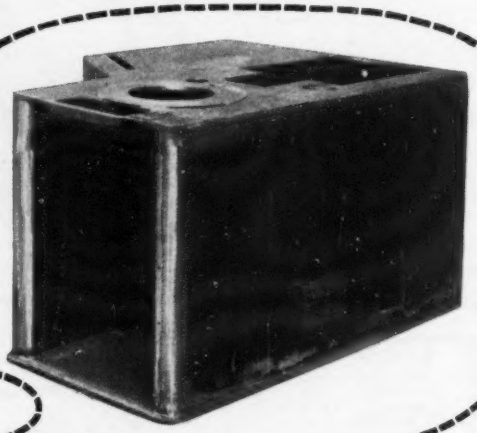

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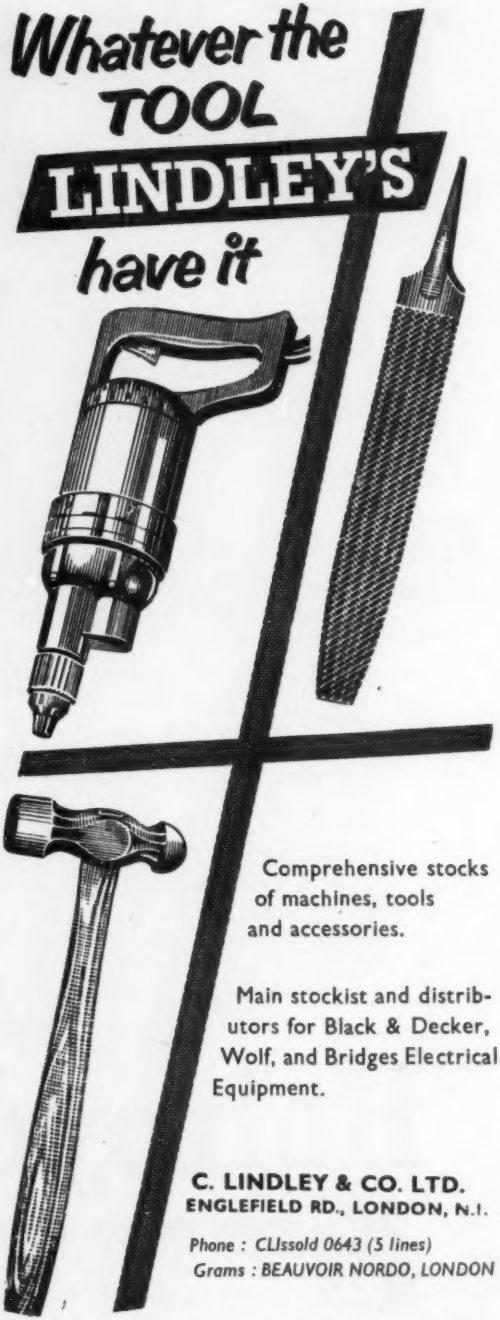

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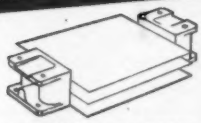

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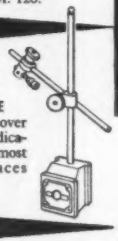

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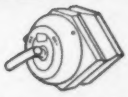

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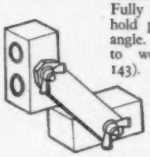

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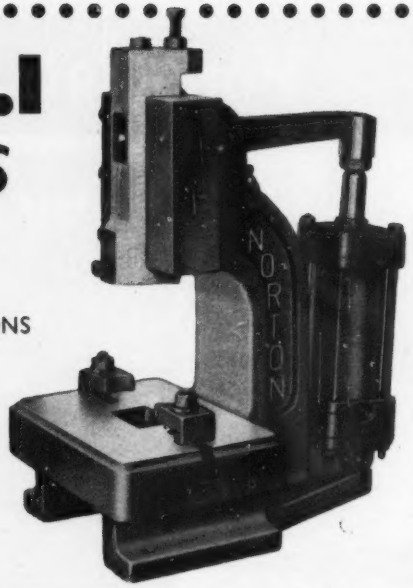

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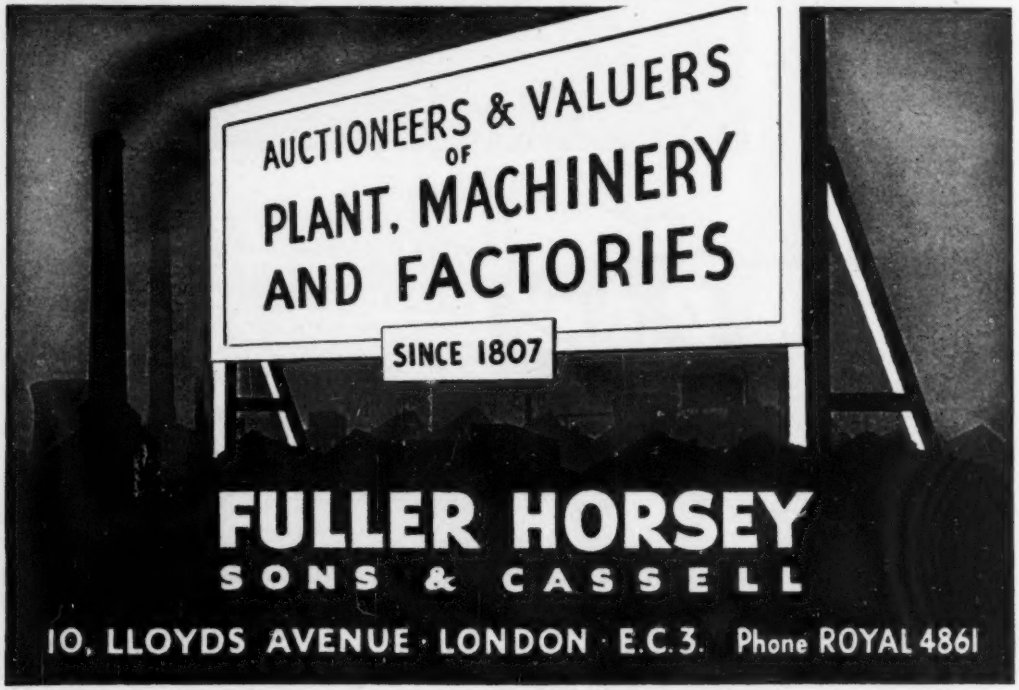

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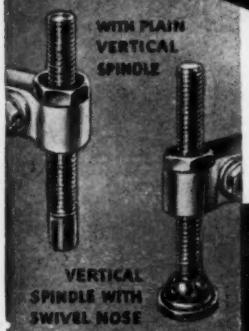

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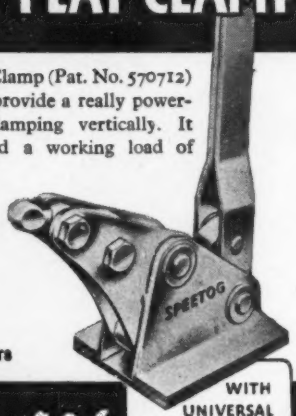

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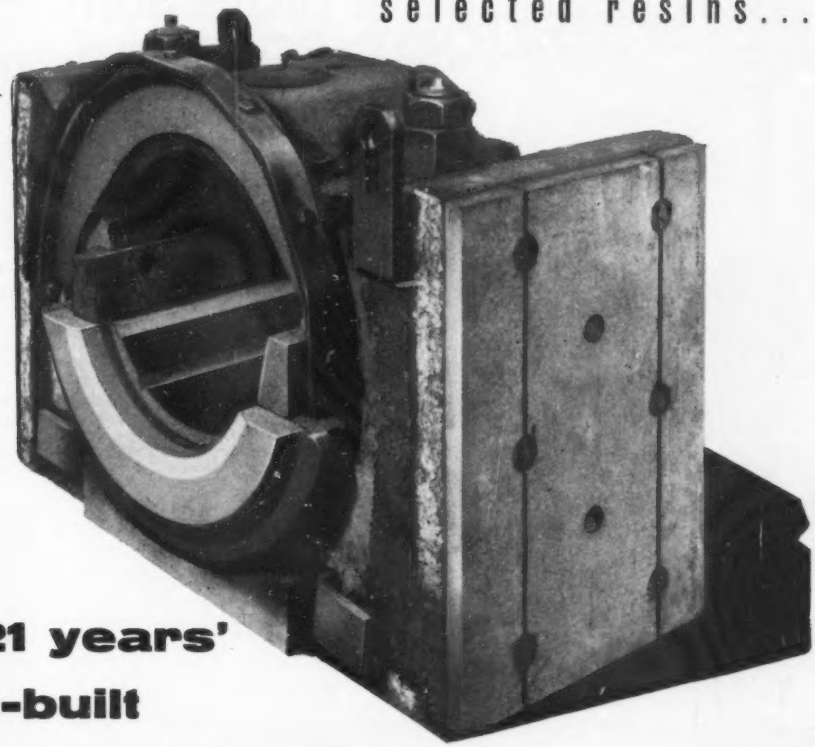

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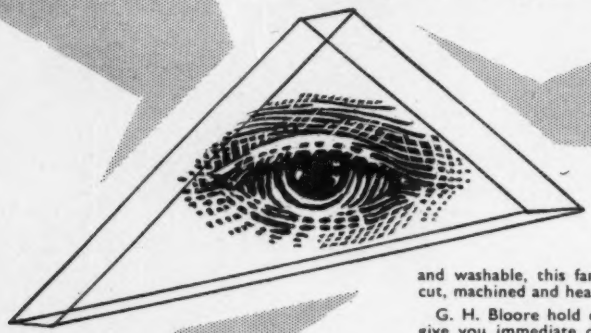

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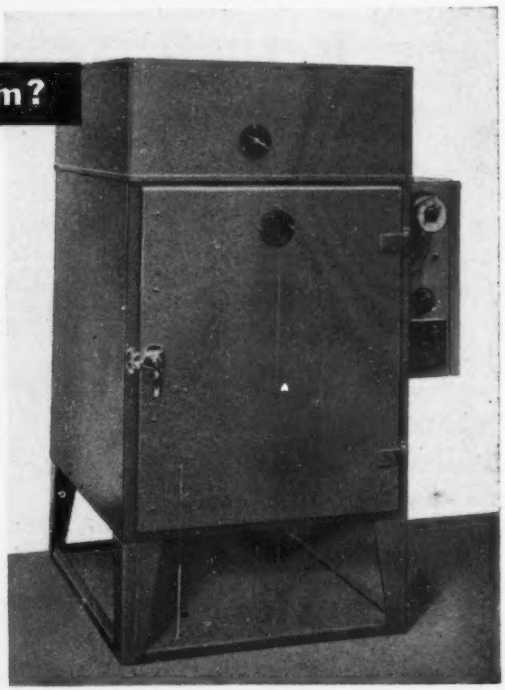

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Close-up showing dividing attachment on rotary table

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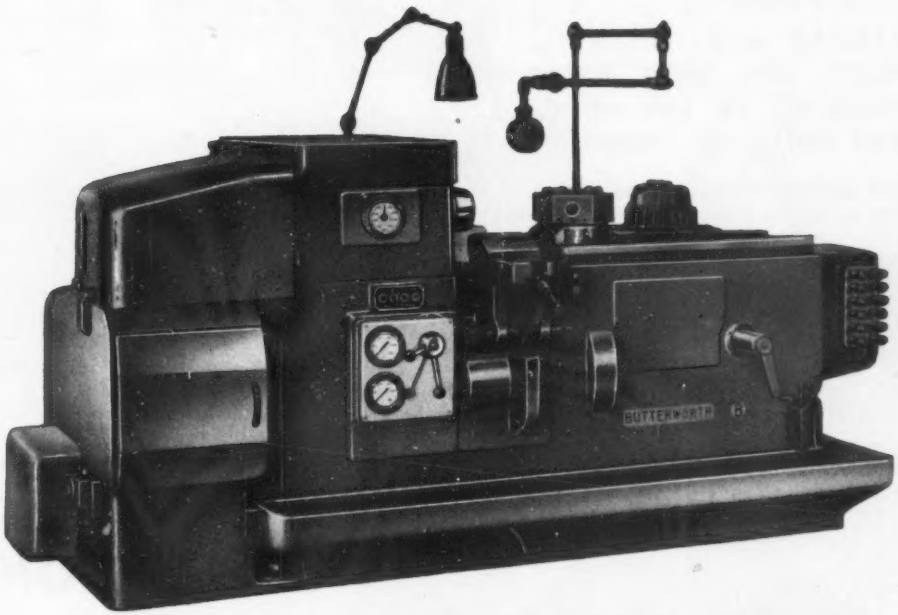

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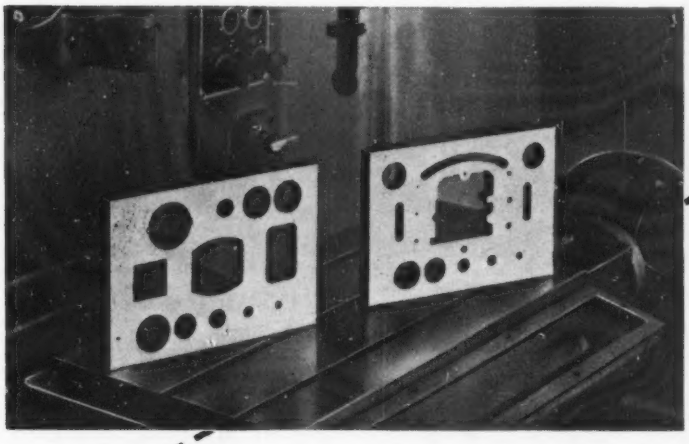

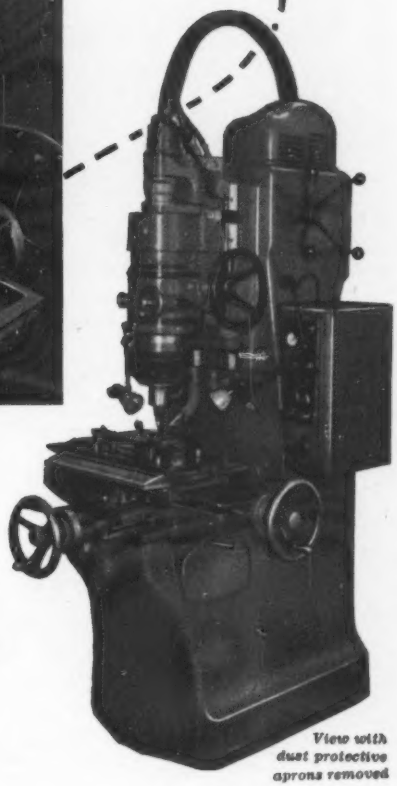

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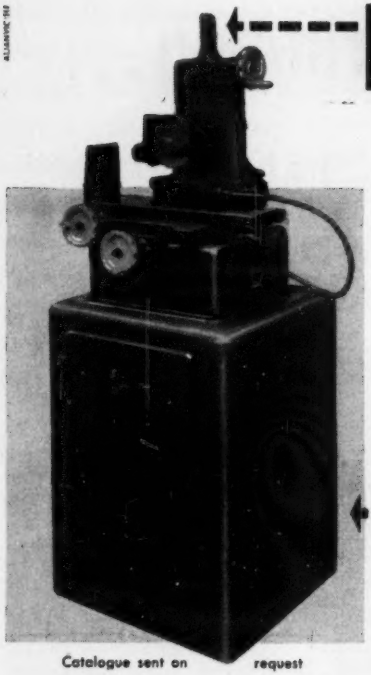

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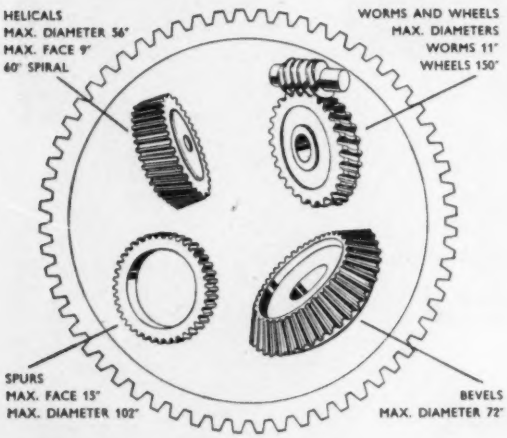

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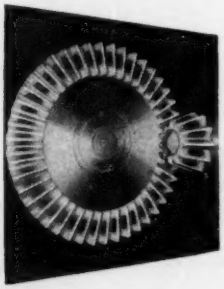

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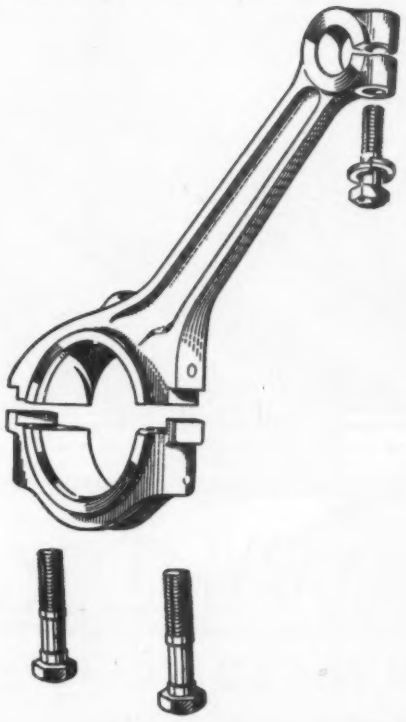

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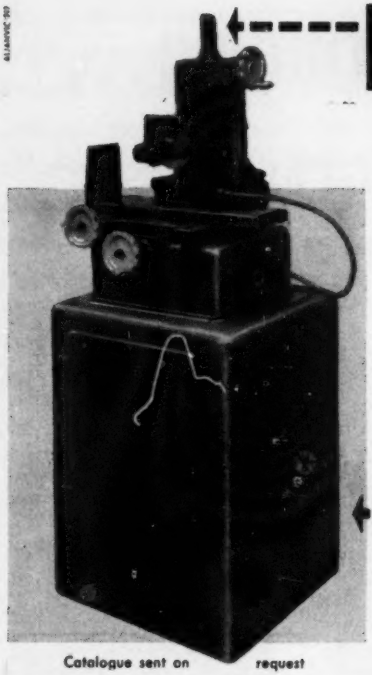

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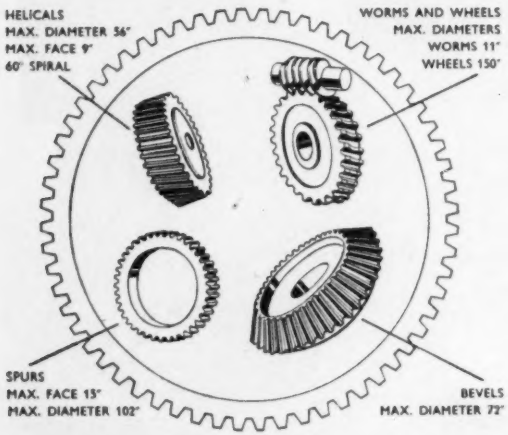

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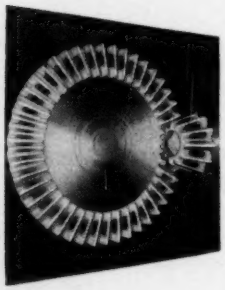

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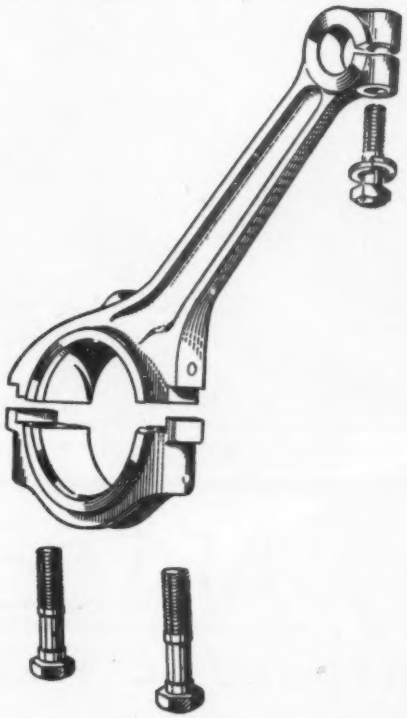

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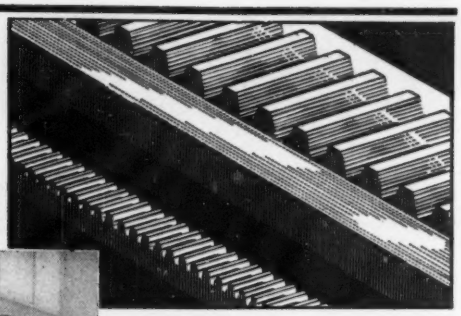

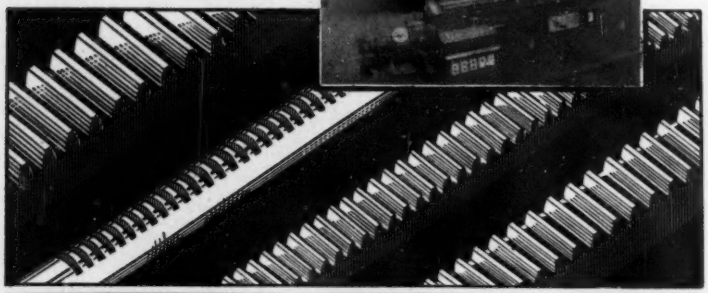

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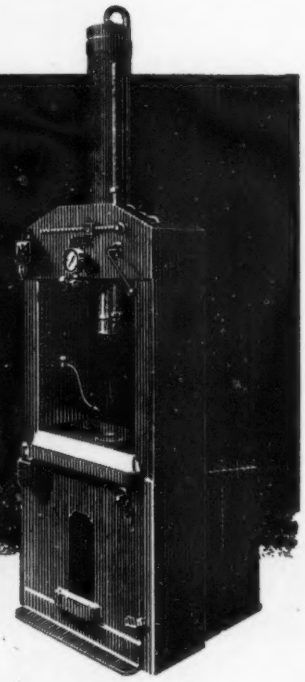

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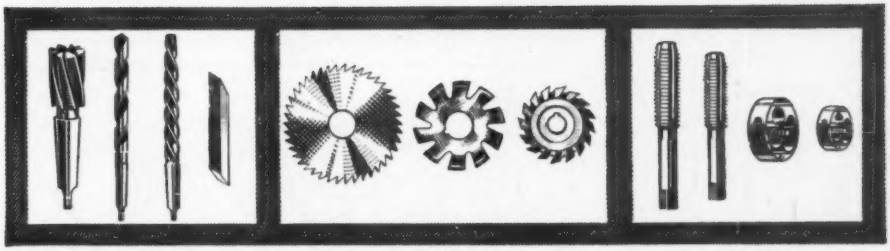

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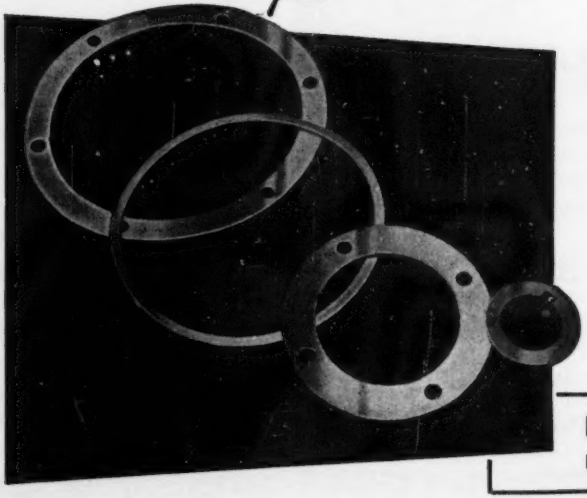

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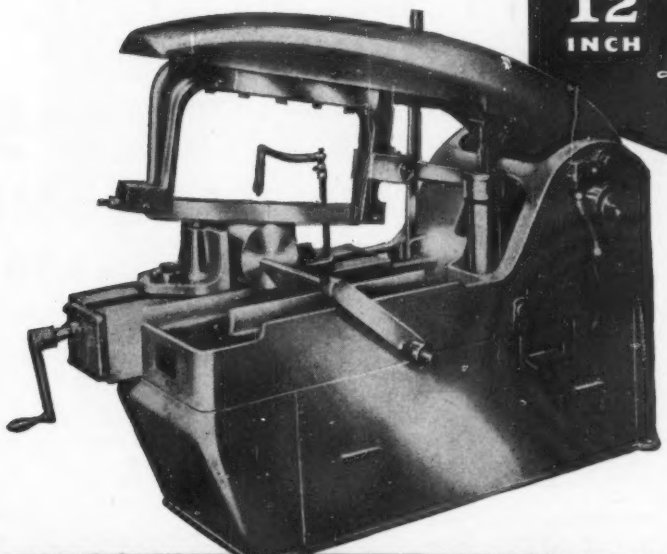

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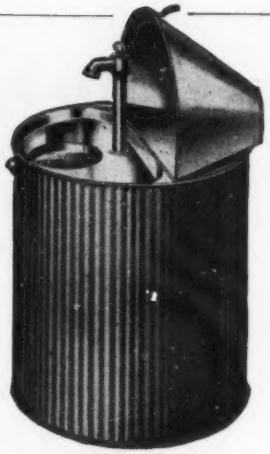

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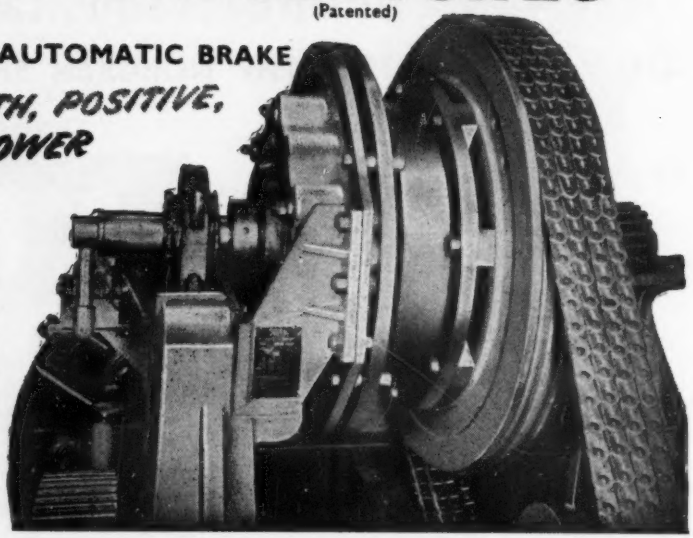

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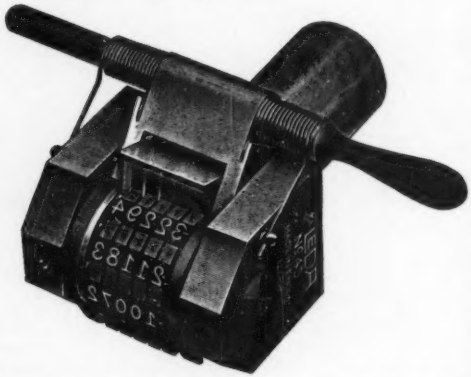

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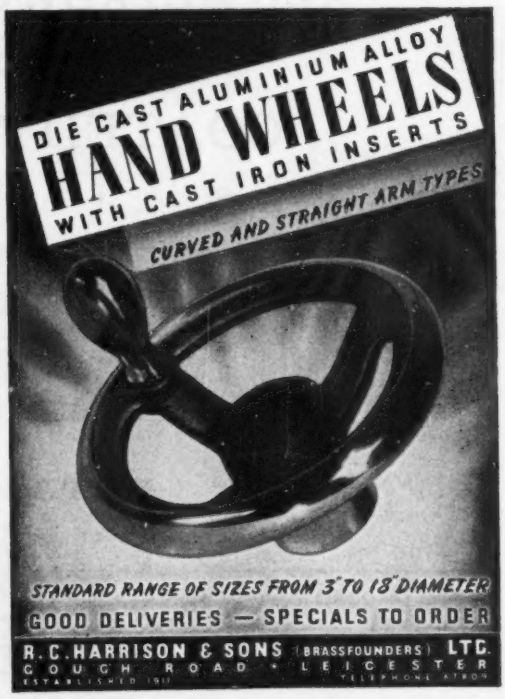
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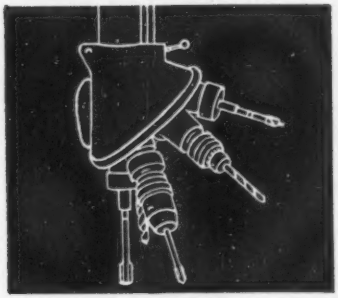

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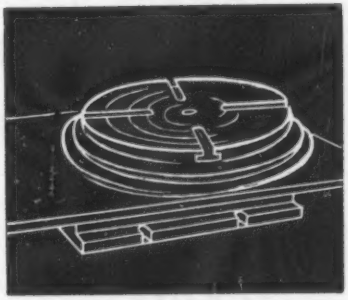

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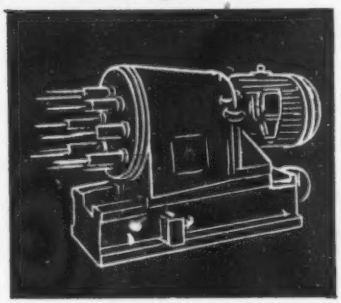

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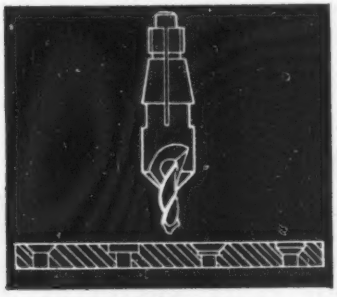

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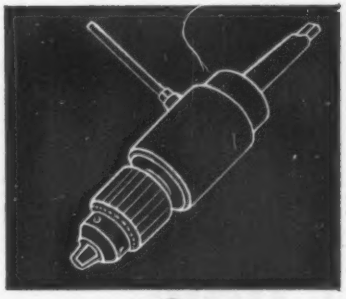

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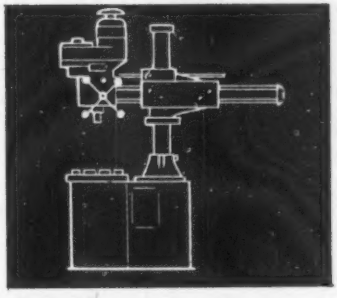

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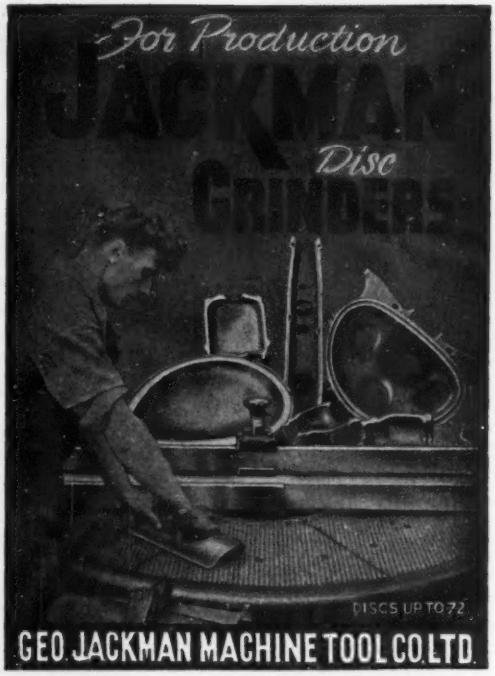

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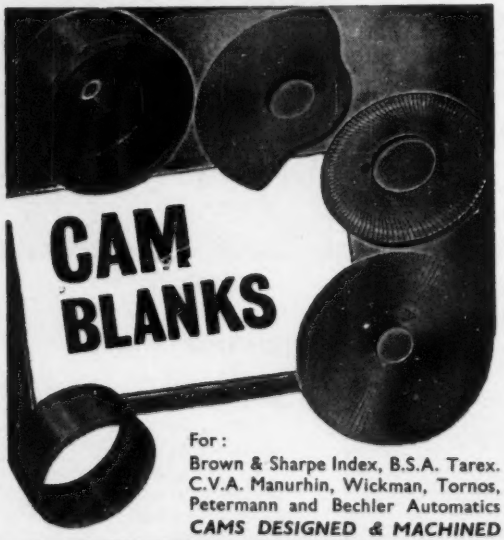

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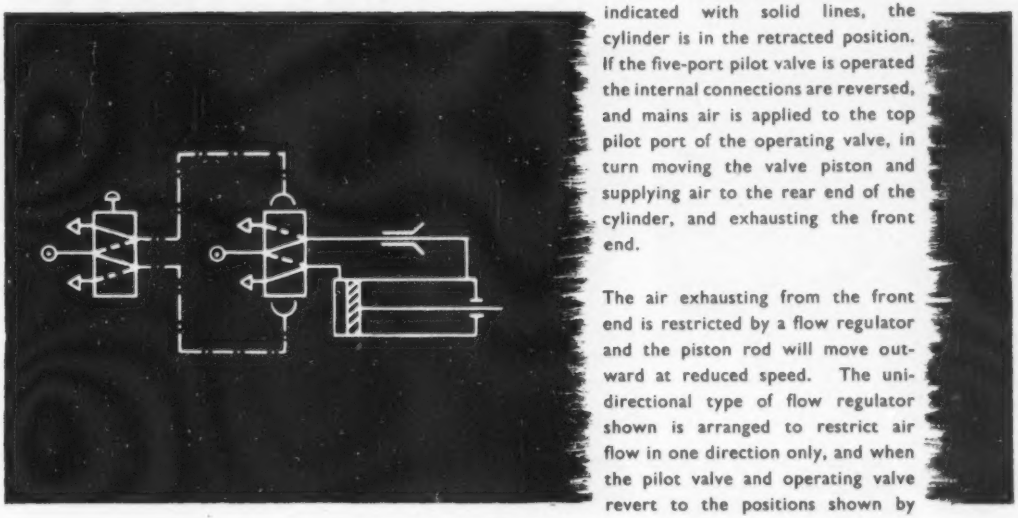

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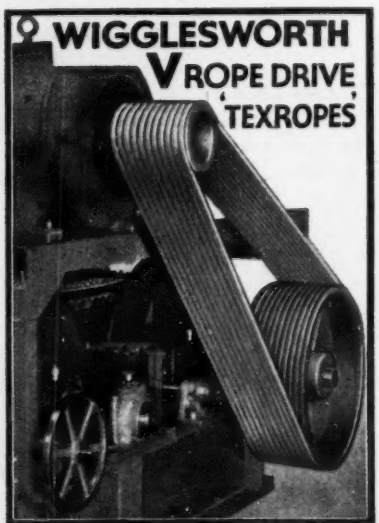

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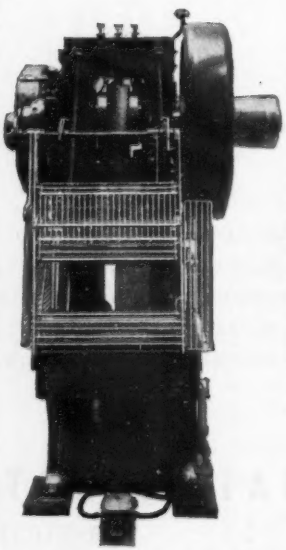

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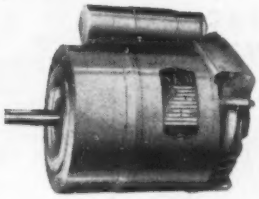

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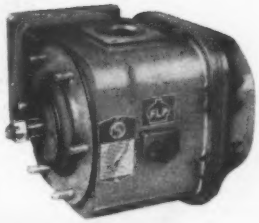

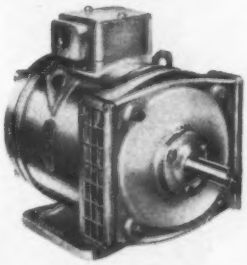

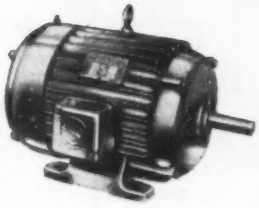

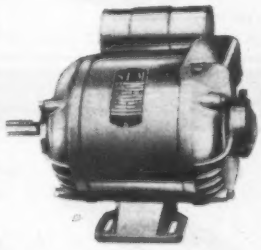

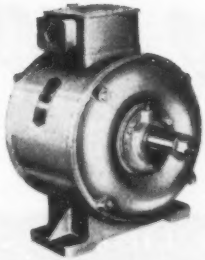

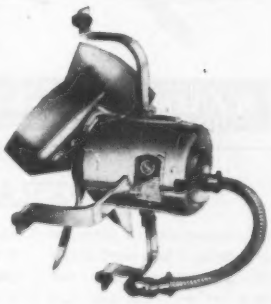

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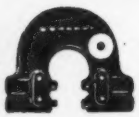

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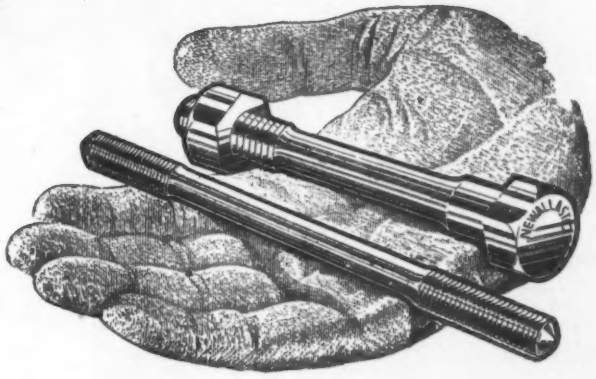

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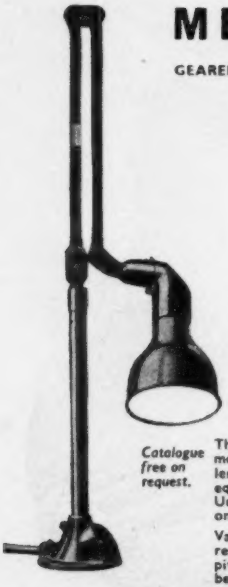

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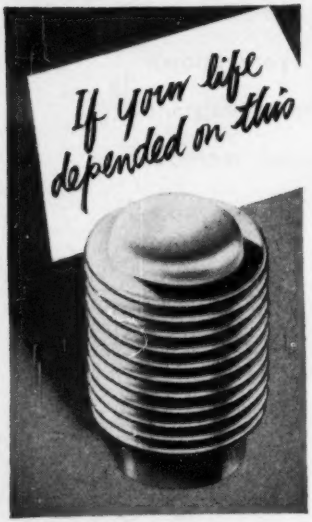

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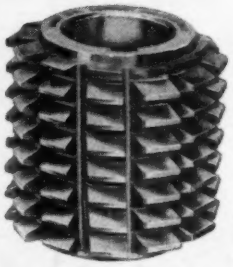

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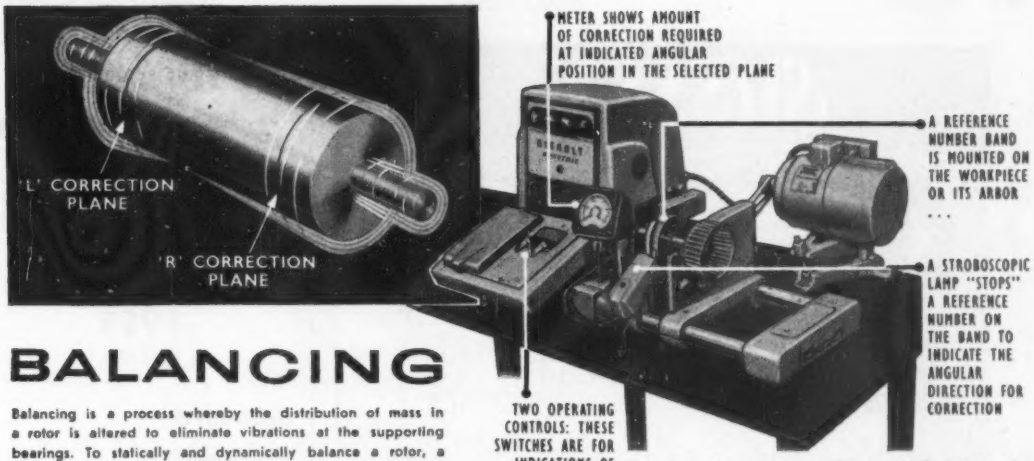
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TWO OPERATING CONTROLS: THESE SWITCHES ARE FOR INDICATIONS OF UNBALANCE IN EACH PLANE OF CORRECTION
'L' CORRECTION PLANE
'R' CORRECTION PLANE

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The above illustration shows the operating principles of Gisholt Dynetric Balancing machines and depicts Type 1SB (BENCH model) for measuring and locating dynamic and static unbalance (either or both) causing vibrations from 0.000025 in., but not exceeding 3/32 in. at bearing surfaces of parts from 1 to 30 lb., 12 in. max. dia. up to 12 in. max. length, and 1⅛ in. or less dia. at bearing surfaces. 1000 to 2500 r.p.m.

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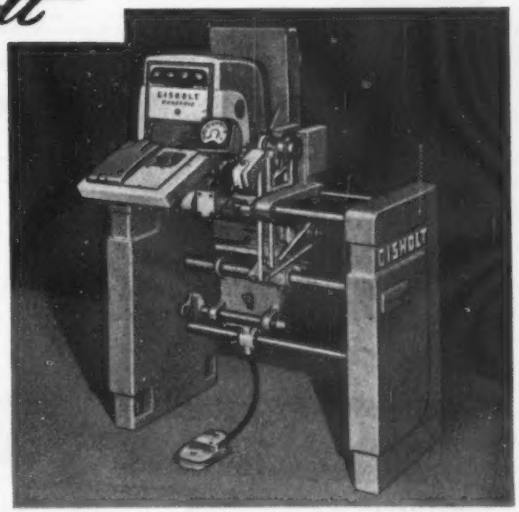
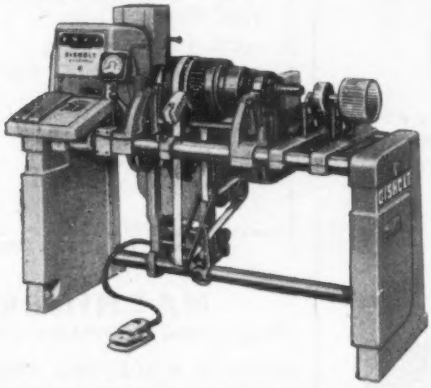


Type 1S (FLOOR type) same as 1SB, above, but including ½ H.P. enclosed motor with brake and control. This machine and its BENCH version can be arranged for parts 2½ in. or less dia. at bearing surfaces (weight capacity 2 to 50 lb.), alternatively ¼ in. or less dia. at bearing surfaces (weight capacity 4 oz. to 5 lb.).



Type 3IS for measuring and locating dynamic and static unbalance (either or both) causing vibrations from 0.000025 in., but not exceeding 3/32 in. at bearing surfaces of parts 24 in. max. dia., 24 in. max. length. Max. dia. at bearing surfaces: 2½ in. (weight capacity 2 to 50 lb.), or 5 in. (weight capacity 15 to 300 lb.), 1000 to 2000 r.p.m.

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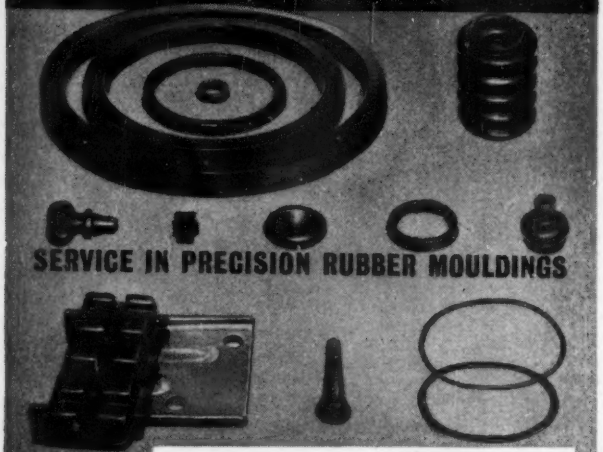

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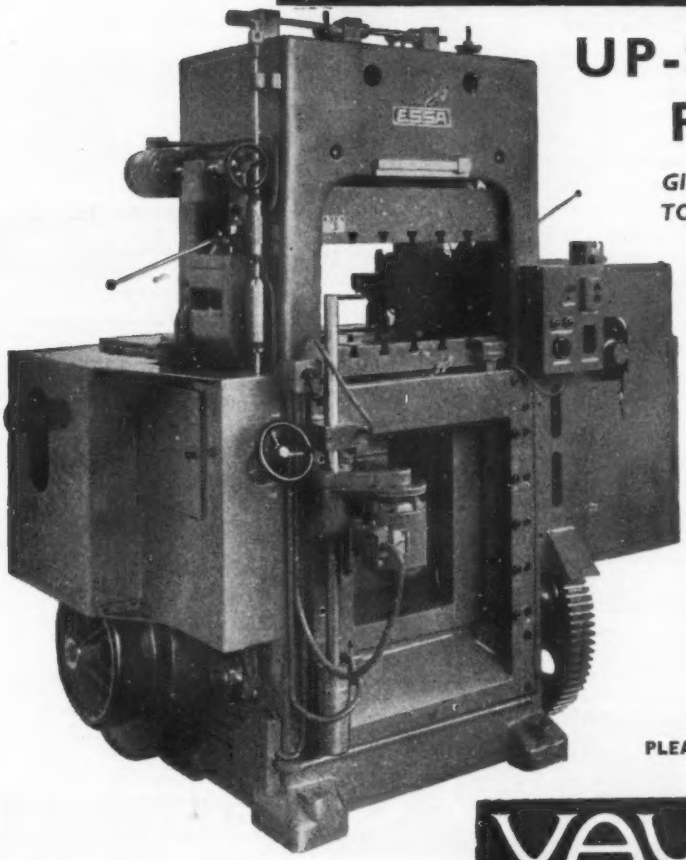

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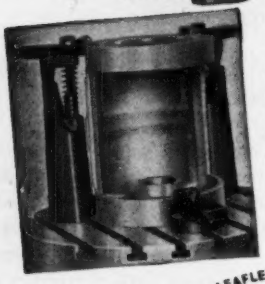

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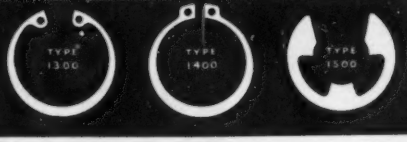

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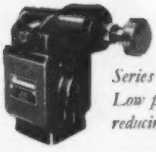

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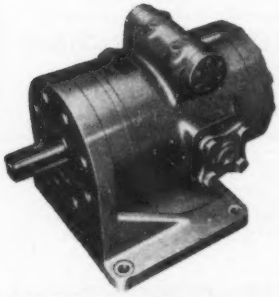

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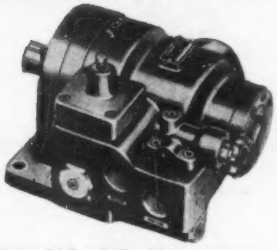

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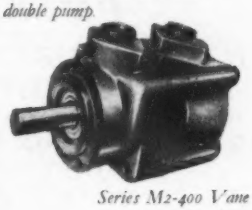

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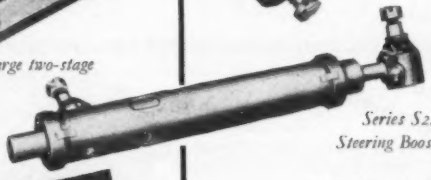

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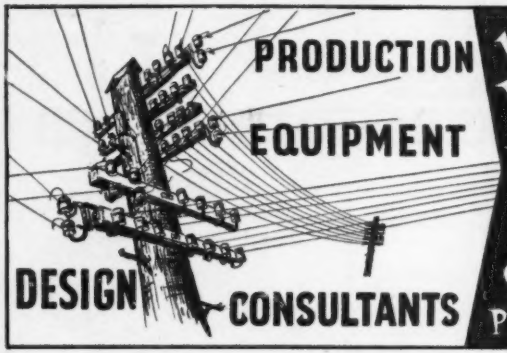

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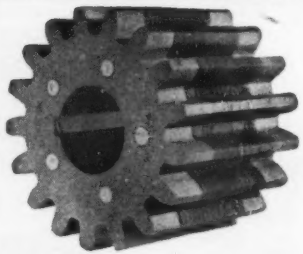

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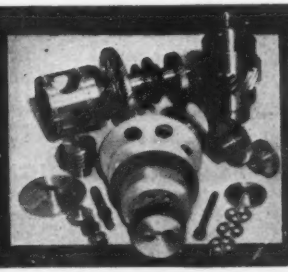

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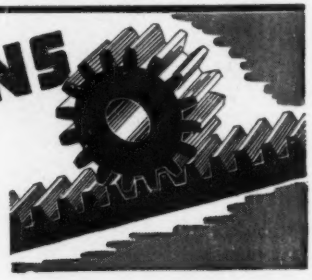

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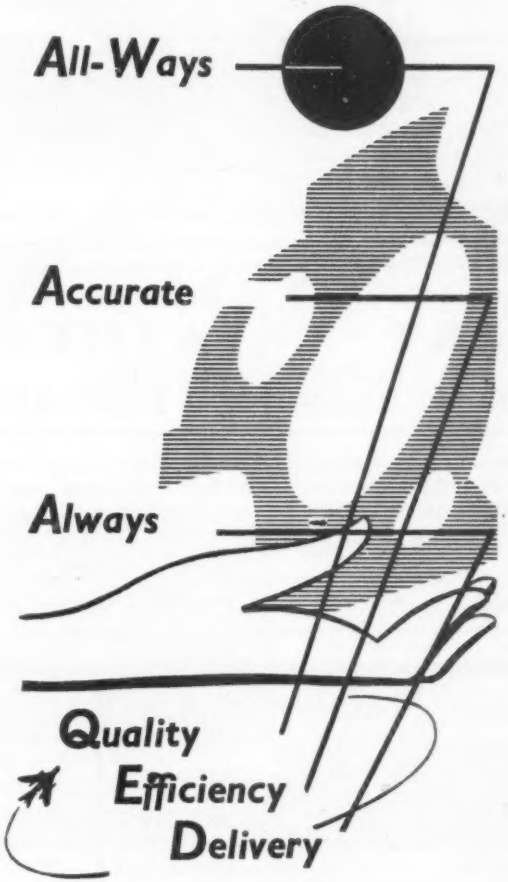

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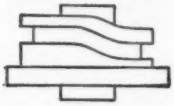

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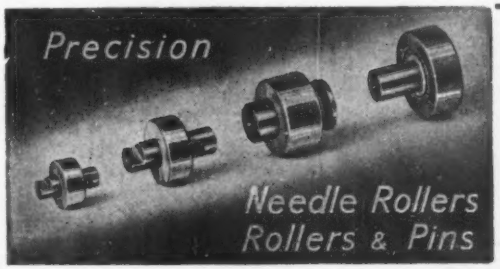

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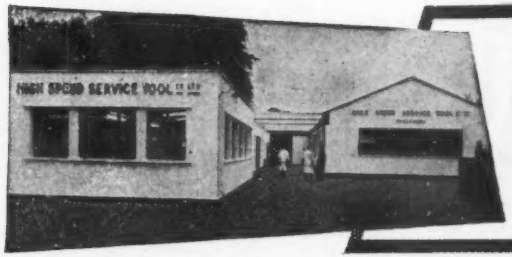

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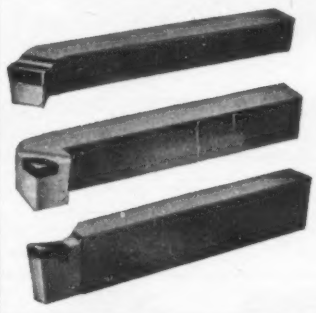

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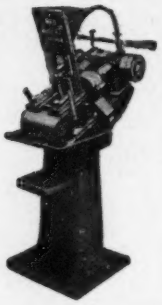

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Classified Advertisements (ANNOUNCEMENTS, contd.)

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Wanted, Horizontal Boring Machine. No. 6 Morse Taper. Secondhand. Must be in perfect condition.—BOX Z254, MACHINERY, Clifton House, Euston Road, N.W.1.

Machine Tools, Power Presses and Sheet Metal Machinery. Single machines or complete plants purchased. Immediate inspection.—ALBERT EDWARDS (MACHINERY), LTD., 79/89, Pentonville Road, London, N.1.

CENTAUR TOOL WORKS, Birmingham, 18, pay best prices for good modern secondhand Machine Tools by first-class makers. Write or 'phone and our representative will call. 'Phone: EDGBASTON 1118 and 1119. 'Grams: Capstan, Birmingham.

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HARRY KIRK ENGINEERING, LTD.,
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Classified Advertisements (*PLANT WANTED, contd.*)

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We pay cash for single machines or complete plants
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ALL TYPES OF MODERN MACHINE TOOLS
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Shaping Machine, 24in. stroke, swivel head, automatic table for horizontal and vertical operation.
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See also Page 178 for adverts received too late for classification

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Richmond (New) HB3/12 4ft. 6in. Radial Drilling Machine, No. 4 M.T. Motorised 400/3/50.—SOUTHERN ENGINEERING & MACHINERY CO., Connaught Buildings, Tanners Brook, Millbrook, Southampton. Tel.: Southampton 73101.

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'Phone: CLErkenwell 6064.

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Large stock of single action and double action Presses for all duties.
PRESSES BUILT TO CUSTOMERS' SPECIAL REQUIREMENTS.
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Replant Works,
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Telephone: WOOlwich 7611/6.

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A Good Number of High-class Machine Tools always in Stock.—ELLISON, Cook Street, off Chapel Street, Salford, 3, Lancs.

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Scrivener No. 1 Centreless Grinder. Capacity up to 1 in. dia. Grinding wheel 12in. by 3in. Motorised.—WILCOX & CO., Barr Street, Birmingham 19. NORthern 1234/5.

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Classified Advertisements (*PLANT FOR SALE, contd.*)

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PARKSON 1NA Universal Milling Machine. Speed Range 17-450 r.p.m. Comprehensive equipment.
EDGWICK No. 2 Plain Milling Machine. Speed Range 21-380 r.p.m.
ARCHDALE 20in. Production Machine. Speed Range 30-619 r.p.m.
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WARD 7, 8A, 2A, 1A Capstan Lathes arranged Bar Feed.
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CHURCHILL 24in. Ring Grinder.
CHURCHILL 42in. Ring Grinder.
SCRIVENER 2C Centreless Grinder.
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TOWN 3ft. No. 3 M.T. Radial Drilling Machine. Speed Range 126-1,450 r.p.m.
ARCHDALE 4 No. 4 M.T. Radial Drilling Machine. Speed Range 80-2,000 r.p.m.
ARCHDALE 5ft. No. 2 M.T. Radial Drilling Machine. Speed Range 126-1,440 r.p.m.
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CLIFTON & BAIRD Punching and Cropping Machine. Cap. 4½in. × 4½in. × ½in. angle.
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Modern Machines—Motorised 400-440/3/50. Fully Overhauled—Six months' Guarantee.

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CINCINNATI No. 2 dial type Vertical Miller.
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SNOW OS12O Surface Grinder.
EMIDECAU 200 ton Hydraulic Press.
BENDING ROLLS (NEW), 6ft. 0in. × ¼in. and 8ft. 0in. × ¼in.

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INDUSTRY WORKS,
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SHEFFIELD, 1.
'Phone: 23314/5.

Colchester 7½in. Triumph, 30in. between centres. Full set equipment and reversing switch. Cost £581, Feb. 1956. Located Surrey.—BOX Z253, MACHINERY, Clifton House, Euston Road, N.W.1.

THOS. W. WARD LTD
ALBION WORKS, SHEFFIELD

MILWAUKEE 2HL Vertical Mill.

Swivel Head. Table 46in. by 9in. 16 speeds. 35 to 1,400 r.p.m. 16 Feeds. ¼ to 20 i.p.m. Power and Rapid Traverse in all directions. Mot. 400/3/50.
Overhauled in first class order, and can be seen running. **£1,225 0 0**

ARCHDALE 18in. Vertical Mill.

Table 38in. by 10in. 18 Speeds. 79/2,000 r.p.m. Power Feeds to table and attachment for Circular Table. Mot. 400/3/50. In first class order. Can be seen running. **£495 0 0**

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Edgwick Vertical Surface Broacher. Slide 66in. by 12in. Table 14in. by 14in. Motorised.—WILCOX & CO., Barr Street, Birmingham, 19. NORthern 1234/5.

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Soag 1¼in. Bar Capstan Lathe. A.G.H. roller bearing spindle, 16 spindle speeds from 33-1,000 revs. Dead length collet chuck, power feed to saddle and turret, 8 long and 8 transverse feeds, machine completely equipped and in excellent condition. Motorised 400/3/50.—MACREE, LTD., Cambridge Yard, Hanwell, London, W.7.

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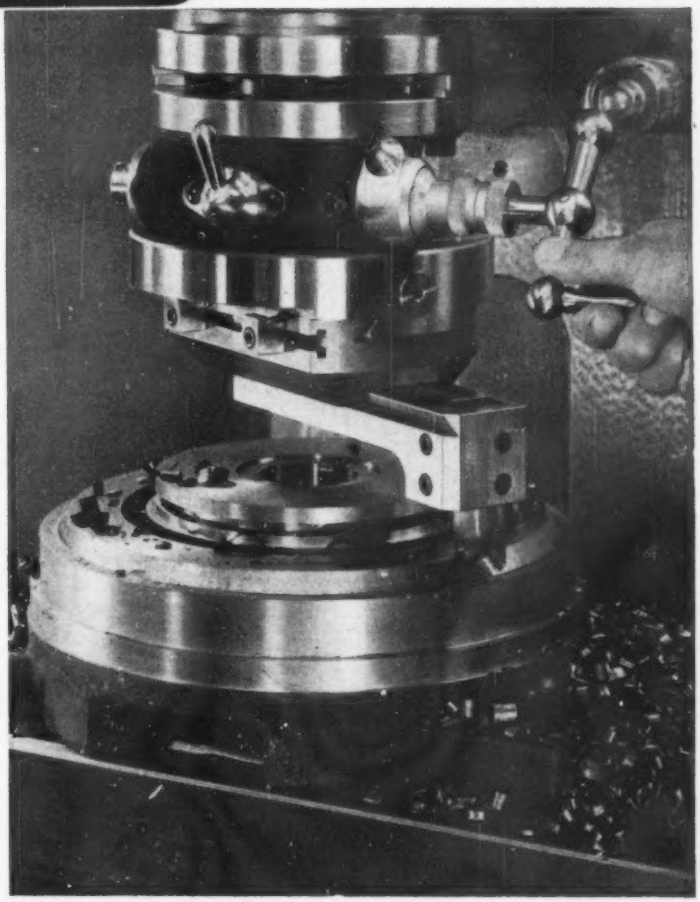

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RYDER WELLMAN Horiz. Borer, 3 insp.
B. & S. OOG S.S. Autos. 1942.
LA POINTE 2SL Horiz. Broach.
VICTORIA U2 Mill, with dividing hds., 1955.
ACME GRIDLEY 2¼in. S.S. Auto, 1942.
MODERN 6in. × 18in. Surface Gdr., 1953.
CHURCHILL OSV 40in. × 10in. Vertical Spindle Surface Grinder, 1942.
ARCHDALE 30in. H.D. Pillar Drill, 1942.
GEBBOLT 4, 6 and 1L Turret Lathes, 1941-43.
WARNER & SWASEY 3, 5 and 3A Turrets.
HERBERT 2D, 4, 4 Senior Turret Lathes.
B. & S. No. 3 Vert. Mill, 1942.
WARD 2A and 3A Capstans, 1942.
ARCHDALE 18in. and 36in. Vert. Mills, 1942.
CINCINNATI 2MH & No. 2 Plain Mills, 1942.
HEALD 48A S. End Borematics, 1941-44.
DEFIANCE No. 5 Hor. Borer, 3in. sp., 1941.
B.S.A. ¾in. S.S. Automatics, 1941.
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NEWALL 10 by 24/48 Grinders, 1942.
MONARCH Magnamatic Prod. Lathe, 1946.
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HERBERT 0, 1 and 33 Plain Mills, 1940.
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CHURCHILL NB 6in. × 18in. S. Gr., 1942.
CHURCHILL Centreless Gr., Model EC, 1940.
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INDEX OR12 S.S. Auto, ¾in. cap., 1940.
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PITTLER Model RE.II.60 Turret Lathes, high speed, 8¼in. centres, 2¾in. hollow spindle.
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CLIFTON & BAIRD 30in. Metal Cutting Bandsaws, table swivels for mitring.
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GOSS & DE LEEUW 5-spindle 8in. capacity Chucking Automatics.
STANLEY 14¼in. centre Gap Bed Boring and Facing Lathe.
RYDER No. 6 six-spindle Verticalauto, capacity 6in. by 6in.
CHURCHILL PBH Universal Grinder, capacity 16in. by 50in.
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KEARNS OB Horizontal Boring, Milling, Drilling and Tapping Machine, 2¼in. diameter travelling spindle. Rapid power traverse to table 30in. by 36in. Fitted screwcutting, outer support, vernier scales.

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47 V **HERBERT**, kneeless type, multi-motor drive, table 72in. by 17in., capacity 48in. by 16in., maximum distance table top to spindle nose 23in., 16 spindle speeds from 21 to 750 r.p.m.
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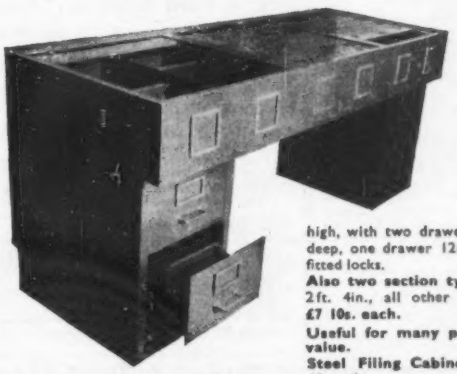

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AUTOMATICS
CONOMATIC ¾ 4 Spindle.
INDEX OR/12, ½in. capacity.
CLEVELAND 1¼in. × 18in. Model B.

CAPSTANS
HERBERT No. 4. Bar feed.
WARD No. 8 Combination. Serial R.
WARD 2A, and 3A Serial M.
GISHOLT No. 4 Simplified. 2in. cap.
DRUMMOND Model K, 1¼in. Bar feed.
HILLE R.H. 15 ¾in. Bar feed.
ACCURATOOL ¾in. Bar feed.
WARNER & SWASEY No. 2 1in. Bar feed.
HERBERT No. 7 Combination Turret.
ACME 5W Universal Turret, 2in. bar feed.
LIBBY 4A 2in. bar feed.
MURAD ¾in. bar feed.
HAHN & KOLB RH25. 1in. bar. Unused.
SOUTHWARK No. 2. 1¼in. bar feed.

DRILLS
POLLARD 21A Mfg. No. 4 M.T.
JONES & SHIPMAN 2-sp., 15in., No. 2 M.T.
GRIMSTON Electriska.
JONES & SHIPMAN 15in. Speed Drill-Max.
HERBERT Type H Junior Pillar.
CORONA 12AX, ⅞in. cap.
BOLEY Cluster Type.
15in. HERBERT Type C, No. 3 M.T.

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T.M.A. Type G.3.
LIENHARD New. All sizes.
T.T.H. Multi Etcher.

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EDGWICK Filer.
RAPIDOR No. 1 Hacksaw.
WICKSTEED Cold Saw No. 1, 6in.

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BESCO 3ft. × 18 g. No. 5 Angle Bender.
BESCO 3ft. × 16 g. swing beam.
KEETONA 4ft. × 14 g. cramp.

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MAXICUT 7in. × 2in. × 6 D.P.
RAPIDAN No. 1½, 2in. dia. gears.
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NORTON 6 × 18 Hyd. Type C.
NORTON 10 × 36. Type C.

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J. & S. 12in. × 24in. 305 T. & C.
EXCEL T. & C.
SCRIVENER No. 1 C.B. Centreless.
JONES & SHIPMAN Carbide.
HERBERT HUNT No. 3 & 4 Drill.

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WRIGHT 8in. Table.
ROBOT 18 × 6.
SNOW P24, 24in. × 8in. Hyd.
ABWOOD 18 × 6 Vertical.

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SAACKE Model VJI, Jig.

GUILLOTINE
KEETONA 4ft. × 14G. Power.

HONER
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KEYSEATER
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COLCHESTER Triumph.
EDWARDS 12in. Spinning.
WILLSON 7¼in. × 3ft. S.S. & S.C.
BRADFORD 8in. S.S. & S.C.
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SMART & BROWN 4in. S.C.
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MILLERS (Horizontal)
BURNERS Bench. Table 14½ × 4.
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VICTORIA M2. Table 40 × 10.
KEMPSMITH No. 1G and 2G.
BROWN & SHARPE No. 12 and 000 prod.
CINCINNATI 08 & 1-18 Prod.
BROWN & SHARPE No. 2 Univ. Light.
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SUNDSTRAND No. 00 Rigidmill.
BURKE. Table 16 × 3¾.
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CINCINNATI 3-24 Hyd.
HERBERT 1S. Table 18in. by 8¼in.

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VICTORIA V2. Table 40 × 10.
ARCHDALE 30in. Table 48 × 12½.
HERBERT 15S. Table 50 × 10¾.

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BESCO TVO Bench, 4 ton.
O. & S. 30 tons straightening.
BESCO EB4, 40 tons. New.
TAYLOR & CHALLEN B2, 10 ton.
RHODES No. 19. 10 ton.
SCHULER VZZ 15 tons d/s gripper feed

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ROTORIVET No. 5 Hammer.
TURNER RS5 and RH14/12.

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OSTER 1in.-6in. Pipes No. 326.
ATLAS No. 2 3in.-6in. (Unused).

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AMCO 6in. Bench.

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SUPERIOR ¾in.
JONES No. 26. 2 B.A.-¾in.
THIEL Nos. 3 & 4.
J. & S. Electrotap ¾in.

THREAD MILLERS
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REINECKER 8 × 72in.
LEES BRADNER Mod. 40. 6¼in. H.M.
HANSON WHITNEY. 8in. × 40in.

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GISHOLT Model 1L Universal Turret Lathe. (Two available.)
LIBBY Model 4A Capstan Lathe.

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R. O'Shea

4/6, Minerva Road, Park Royal, LONDON, N.W.10.
Telephone: ELGar 4841-4842.

SECONDHAND.

Mann Vertical Milling Machine. Swivel and sliding head. Table size 46in. × 11in. Flange M/D 400/3/50.—ALBERT EDWARDS (MACHINERY), LTD., 79/89, Pentonville Road, London, N.1. 'Phone: Terminus 0167/8/9.

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WE HOLD BIG STOCKS OF LATHES, SHAPERS, MILLS, DRILLS AND PRESSES.

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Edwards

TAYLOR & CHALLEN No. 576. Open Fronted Inclinable Power Press, with detachable front tie bars. Pressure exerted approximately 20 tons. Stroke 3in. Tee slotted bed 27½in. × 22½in.

RHODES No. 218. Motorised Direct Flywheel Driven Open Fronted Inclinable Power Press. Arranged motor drive for 440/3/50. Motor mounted on adjustable platform on top of machine. Fitted with automatic press guard and guard covering vee rope drive. Size of bed 30in. × 21in.

MILNE Geared Double Sided, Double Action, Toggle Drawing Press. Mounted on cast iron legs. Punch stroke 7in. Blankholder stroke 5in. Between uprights 20½in. Size of bed 19½in. × 16½in. Weight approximately 60 cwts.

NEW **BESCO** Production Eccentric Geared Power Punching Press. Model EBG6. Mark 2. Arranged motor drive for 400-440/3/50. Fitted with double automatic roll feed with adjustable material guides. Pressure exerted approximately 70 tons (short stroke). Stroke adjustable from ½in. to 3½in. Size of table 26in. × 19½in.

BLISS No. 85. Double Geared, Double Sided, Reducing Press with straight sides. Arranged for motor drive, 400/3/50. Pressure exerted approximately 50 tons. Stroke 14½in. Between uprights 22in. Bed 21in. × 21in.

WESTON Model 400/100. Double Sided Friction Screw Press, of welded steel plate construction. Arranged motor drive for 400/3/50. Fitted with air-operated sliding tables at front and back of bed to facilitate loading of work under dies. Pressure exerted approximately 120 tons. Maximum stroke 11in. Diameter of screw with four starts 6½in. Size of sliding tables 22½in. × 16½in.

Photographs of the above are available.

MACHINE TOOLS, NEW AND USED, Of Every Description. Attractive Prices.

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359-361, EUSTON RD., LONDON, N.W.1

Telephone: EUSTON 4681-3771.

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Rapidor (New) 1A.H.D., 8in. capacity Hacksawing Machine, 3 speed. Motorised 400/3/50.—SOUTHERN ENGINEERING & MACHINERY CO., Connaught Buildings, Tanners Brook, Millbrook, Southampton. Tel.: Southampton 73101.

SECONDHAND

Bliss 20B, 25-ton Inclinable Power Press. Adjustable stroke ½in.-2½in. M/D 400/3/50.—ALBERT EDWARDS (MACHINERY), LTD., 79/89, Pentonville Road, London, N.1. 'Phone: Terminus 0167/8/9.

Cunliffe & Croome No. 2 Vertical Miller, Serial 37019, 56in. × 12in. table, 1954 machine.—A. MCNAMARA & CO., New Line, Bacup, Lancs. 'Phone: Bacup 946.

Raskin 20 Ton Power Press (R2). Adjustable stroke. Like new. Current model. £245. Federal 10-ton ditto. £115.—400/3/50.—BOX Z307, MACHINERY, Clifton House, Euston Road, N.W.1.

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CENTAUR

MACHINES OF QUALITY

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GRANOR OF HALIFAX 11in. Gap Bed Lathe by 8ft. 0in. b.c. Hole in spindle 3⅛in. dia. 400-440/3/50.

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MITCHELL OF KEIGHLEY 12½in. Gap Bed Lathe by 6ft. 9in. b.c. 400-440/3/50.

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NEWALL Type L 10in. by 24in. Plain Grinding Machine. 400-440/3/50.

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ARCHDALE 18in. High Speed Vertical Milling Machine. Table size 38in. by 10in. Spindle speeds 79-2,000 r.p.m. 400-440/3/50.

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WILSON 7½in. by 40in. gap bed, motorised.

BERRY A.G.H., 6½in. centre by 32in., in gap 26in. motorised.

MITCHELL 7½in. by 42in. by 25in. gap, A.G.H., motorised.

CHURCHILL CUB Lathe, 6in. by 24in., A.G.H., mot. 415/3/50.

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WICKMAN Auto., cap. 10mm., motorised.

WARD 2A, A.G.H., bar feed, motorised.

WARD No. 7 A.G.H. Bar feed, ball chuck, etc., motorised.

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OLIVER Quick Work Shear, cap. ½in., throat 30in.

RHODES Fluifeed Hydraulic Guillotine, 6ft. by 14ft. Gauge, Micro stops.

THERMIC Muffle Furnace, 15in. by 24in. by 12in., has heated pyrometer 1,000 deg. C

T. & C. B1½ and B2, motorised.

RHODES 40 ton inc., motorised.

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CINCINNATI No. 2 Dial Type Horiz. Mill.
CHURCHILL Crankshaft Grinder, 50in. by 20in.; modern, excellent condition.
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10ft. by 6in. LUMSDEN Slideway Grinder. Table 10ft. by 6in. by 46in. Hydraulic. Two horizontal and one vertical grinding wheels.
No. 7 WARD Covered Bed Capstan Lathe. Arranged for chucking, some equipment.
2S HERBERT Bar Feed Capstan Lathes. £75 each.
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No. 3 GISHOLT All Geared Capstan Lathe. Bar Feed.

DIMCO (Gt Britain) LTD.,
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SHEpherd's Bush 4401

CRAVEN HEAVY DUTY LATHE. 36in. centre height, 38ft. between centres, 52ft. overall length. Flat bed 50in. wide 2 saddles. Leadscrew (2 T.P.I.), 5ft. faceplate. Drive by 35-h.p. motor. Weight about 30 tons.
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MUNCASTER MACHINE TOOLS LTD.
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Herbert Hacksaw, 13in. blade, belt driven.
Wicksteed Hydrofeed Hacksaw, 16in. blade, 6in. by 6in.
Rex Hydraulic Hacksaw, 18in. blade, 8in by 8in.
Colchester 7in. Centre Lathe, 7ft. gap bed, A.G.H.
Herbert Horizontal Milling Machine, 3ND table 61in. by 15in., 4 spindle speeds.
3,000 K.G. Capacity Avery Hardness Testing Machines, 10in. dia. table (2).
V. & O. 50-ton Inclinable Geared Open Fronted Press.
Crow Harvey Punch, Shears and Angle Cropper, 18in. blade, 27in. throat, heavy duty.
Pels Punch, Shears and Cropper, 12in. blade shear ¼in., takes 6in. by 6in. by ¼in. angles.
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Robertson Shears, ¼in. capacity, 10 h.p., 28in. blade, 9in. maximum opening. (2)
Robertson 7-roller Plate Flattener, 8ft. 6in. wide, approximately ¼in. capacity.
Berry 3-roller Plate Bender, 7ft. wide, approximately ¼in. capacity.
Sweeney Fly Presses, all sizes, 20 available.
New 1-cwt. and 2-cwt. Hammers by Massey and Alldays & Onions, also 3/5 cwt. secondhand.
Oliver Planishing Hammer, 29in. gap.
FRED WATKINS (ENGINEERING), LTD. Coleford, Glos. 'Phone: Coleford 2271 (3 lines).

Acme-Gridley 1⅛in. Automatics, type R.4 screwing spindles, stock carriers, etc., very good condition, reasonable offer accepted.—C. L. THOMAS, LTD., 18, Park Avenue, Solihull 1281.

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All the above motorised 400/3/50.

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TIPton 2141

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TAYLOR & CHALLEN Ditto. ½in. stroke. £175.
BLISS No. 21 type Inclinable Power Press, with motor and platform, 2in. stroke. £200.

4/6, Minerva Road, Park Royal, LONDON, N.W.10.
Telephone: ELGar 4841-4842.

H. BELL (MACHINE TOOLS) LTD

Offer from stock:
PLANING MACHINE, 10ft. × 3ft. × 3ft. Table 10ft. × 2ft. Rack driven.
WICKMAN 1⅞in. Single Spindle Bar Auto, with bar feed slotting and screwing attachment.
KENDALL & GENT No. 3 Horizontal Broaching Machine. Screw operated. 20-ton pull. Max. stroke 50in.
New **KERRY** 100 1in. Pillar Drill. Spindle No. 3 M.T. T-slotted swing aside table. 9 speeds 70-1,500 r.p.m.
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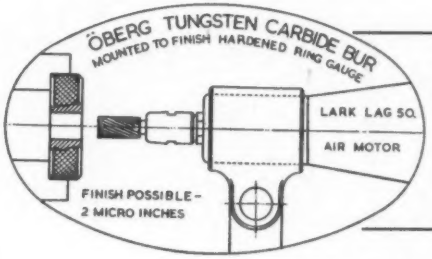

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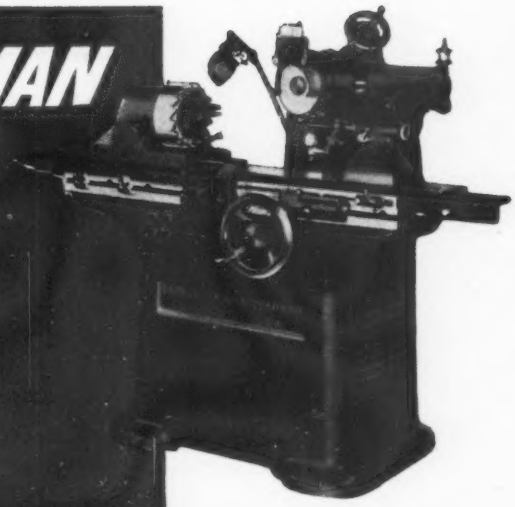

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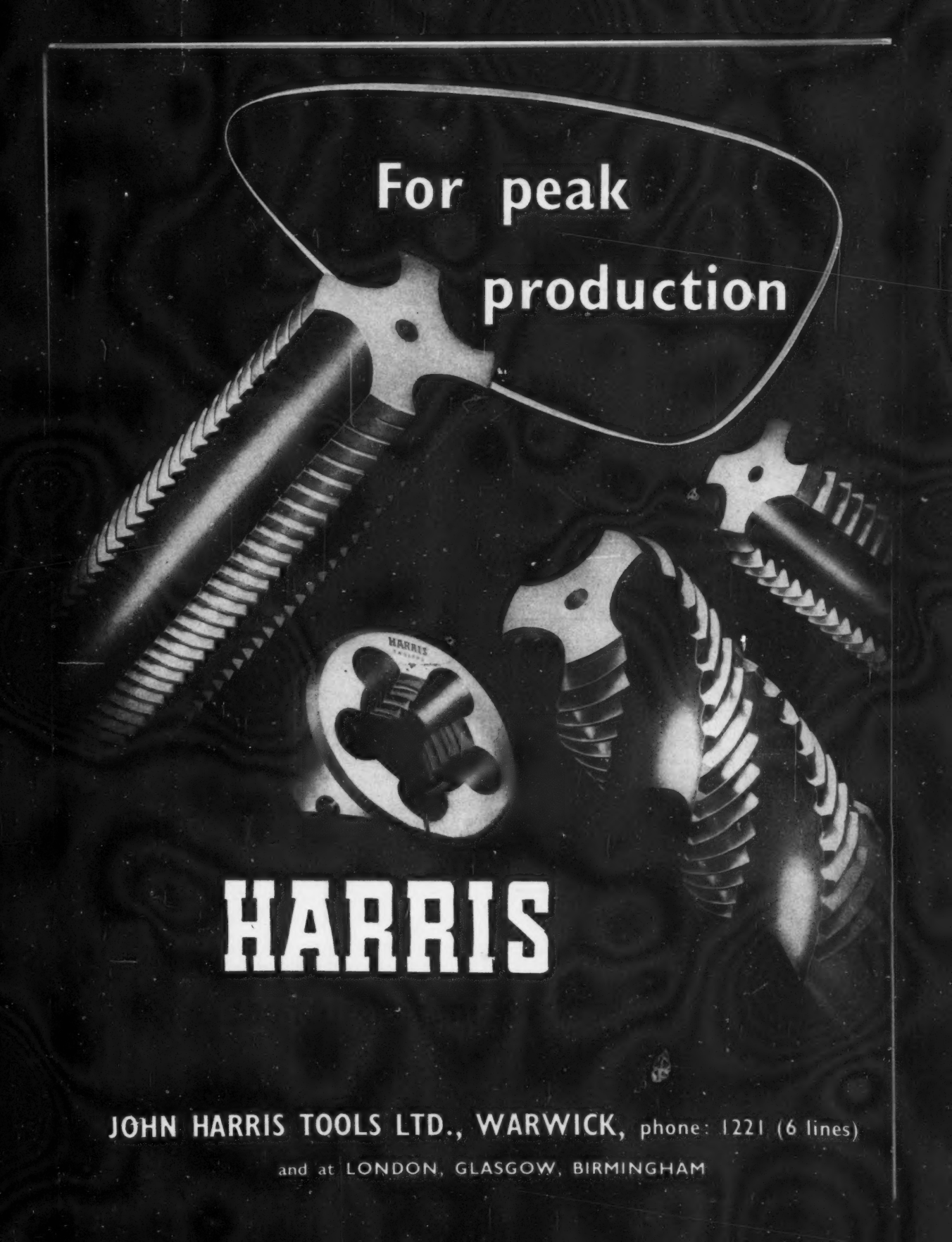

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